MELANIE LYNN REES
Patterns for Children's Play in Revitalized Urban Streams
(Under the Direction of MARGUERITE KOEPKE)

Children's play spaces in urban environments often offer no exposure to or interaction with water or other natural elements. Urban streams are typically degraded and polluted. The restoration of streams in the urban environment can improve urban ecology and hydrology and provide places for children to safely play and experience nature in the city.

This thesis explores the possibilities of play in urban streams through patterns of children's play with water. Each pattern is identified and defined graphically and with specific design criteria. The patterns are applied to a design for a portion of Tanyard Creek in Athens, Georgia.

INDEX WORDS: Stream restoration, Water play, Tanyard Creek, Landscape architecture

PATTERNS FOR CHILDREN'S PLAY IN REVITALIZED URBAN STREAMS

by

MELANIE LYNN REES

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MELANIE LYNN REES

Approved:

Major Professor:	Marguerite Koepke
Committee:	Marianne Cramer Judy Meyer Ron Huffman

Electronic Version Approved:

Gordhan L. Patel
Dean of the Graduate School
The University of Georgia
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CHAPTER 1

INTRODUCTION

Water, Children and the Environment

Water is universal. It is the basis of all life as we know it and is essential for survival. Water has infinite uses. It can be a tool, a luxury, a necessity, or a toy. Water has a multitude of uses and many layers of meaning. In the urban environment, clean, pure water is available from the tap, but almost nowhere else. Clean, pure, naturally occurring water is a very valuable resource in the city.

Water's playful aspects and children's natural affinity for it make it a wonderful part of learning and formative play experiences. It is, in fact, entirely natural from an evolutionary standpoint that both adults and especially children respond positively to water in the landscape (Kellert 90). Play is a child's opportunity to learn about some of the intricacies of water and its place in the natural system.

It is not only essential for life, but also a key to understanding our natural environment. This understanding often comes to children without effort, from exposure to water in its many forms – the bath, a glassful, the stream, or the ocean. Ideally, these experiences would be available to all children. Unfortunately, many urban children have a smaller variety of experiences with water than children growing up in other areas. Urban children in general have fewer natural spaces in which to play than those growing up in more rural areas, who may have access to woodlands, streams, and other undeveloped spaces.

Children need to interact with "natural" environments, as these lessons are formative and affect adult opinions, priorities, and values. On the whole, our society needs to be more environmentally aware and have a greater appreciation of man's place in the earth's ecosystem. Children with positive outdoor experiences will become adults who observe and care about their environment. As they grow and mature they will demand meaningful interactions with nature throughout their lives and for their own children. “If we want a culture that values water, children must play with it so that it might become part of the individual’s inner being” (Moore, Natural 44).

The basic problems of the urban hydrological system include flooding, low levels of groundwater, pollution, and more. Many streams have become a part of the urban sewer and storm water systems and no longer resemble their natural state. Stream restoration improves a city’s ecosystem and makes part of the natural world visible and accessible. The restoration and recreation of natural water elements in urban areas offer opportunities for urban children to experience play with water.

Cities, Nature and Play

The current state of water in urban areas is a symptom of the view of cities as machines. Man has almost universally tried to dominate and control nature since before the Industrial Revolution. The advent of modern science and technology provided humans with more power to change the environment than ever available before. This power and the desire to mold chaotic nature into order resulted in ever higher and larger cities. The modern city initially had no place for nature (or children), but existed as man’s ultimate machine.

This attitude of excluding nature from the city began to change with the advent of leisure and social spaces in the city. Frederick Law Olmsted, among others, began to bring nature into the city late in the nineteenth century. Central Park, considered New York City’s “green lung,” originated as a space for various social classes to interact in a picturesque setting. A piece of nature is introduced into the city, but only as a backdrop, not for interaction. At this time the first playgrounds arise, which also offer nature as merely a setting for physical education.

As theories about children’s play and learning evolved, playgrounds added ways for children to interact with and manipulate the environment. Adventure playgrounds in particular offered freedom, excitement, and room for creating, but there was little or no nature represented. This era of play acknowledged children's need for a variety of stimuli, but did not provide access to natural systems within playgrounds, which are purely urban places. This phenomenon reflects the idea that pieces of nature are found within the city, but remain separate from the urban fabric.

Today's concept of play with and within nature is a new one. Children can learn firsthand about their place in and their impact on the environment. This trend is occurring as the city begins to be perceived not as a machine that is separate from nature, but as part of a greater system. The city and man create layers of natural processes in the urban environment that can be studied as a unique system. Play is one of the first opportunities for a person to do so.

Purpose and Methodology

The purpose of this thesis is straightforward. It examines the overlap between children's play and urban streams. It will identify archetypal play settings that may be used to design children's play spaces in revitalized urban streams.

In order to accomplish this purpose, the methodology includes two chapters that review the history of play and hydrology. Using this information as a background, chapter four examines some case studies of renovated streams and identifies patterns of children's play with water. Chapter five expands the patterns and defines them verbally and graphically. Finally, the patterns are applied to a portion of Tanyard Creek in Athens, Georgia, and the thesis is evaluated and discussed.

CHAPTER 2

PLAY IN URBAN ENVIRONMENTS – HISTORICALLY AND TODAY

The concept of play and its necessity for children's development is a new one relative to the age of humans and cities. Yet it was the pressures of urban life, more specifically industrialization, that eventually formed the need to provide places for children to play. This chapter follows the play movement from its inception to today. Previous to the existence of intensely developed cities, children explored, played, and learned in the rural environments of garden, farmyard, and woodland. Even small towns and cities afforded nearby farms and open space for play. This situation eventually gave way to situations common today, urban children with no natural places to play at all. At best, cities provide sterile playgrounds with no connection to nature. Even the vacant lot, previously a fairly benign place for exploration, may today be home to drug users, crime, or other dangers. The urban child has no place to experience nature within the city.

The Birth of Play and Playgrounds

The play movement in the United States arose from a variety of social pressures that developed in the late nineteenth century. Industrialization caused an increase in the urban population, especially immigrants, which generally suffered from a lack of exposure to natural spaces, poor sanitation, overcrowded living and working conditions, poverty, and pollution. Children no longer worked on the farm for several months of the year, but attended school for long periods of time in the rapidly growing system of public education, or worse, labored in factories. A combination of poor living conditions and decreased outdoor activities resulted in a general decline in the health of urban children. In a time of increasing philanthropy and a new social spirit, play and physical education for children emerged as a pressing social issue.

Early arguments for children's play were founded in welfare issues. Play was a means for physical and social education. Through play and organized games, children could let off steam in a positive way, keeping them out of trouble on the streets, and improving their concentration and attention span in school. Games and gymnastics improved muscle coordination and taught good sportsmanship. Play produced robust, healthy boys and girls.

Play Movements

Early nineteenth century play focused on physical education and recreational games for children. Play was a means of education, physically, socially, emotionally, and intellectually. Early in the movement, few people acknowledged the value of play as fun for children. Rather, play was viewed as physical education and a means of improving children. As leisure and recreation generally gained importance in America, so did the value of play for its own sake, not only for its educational value.

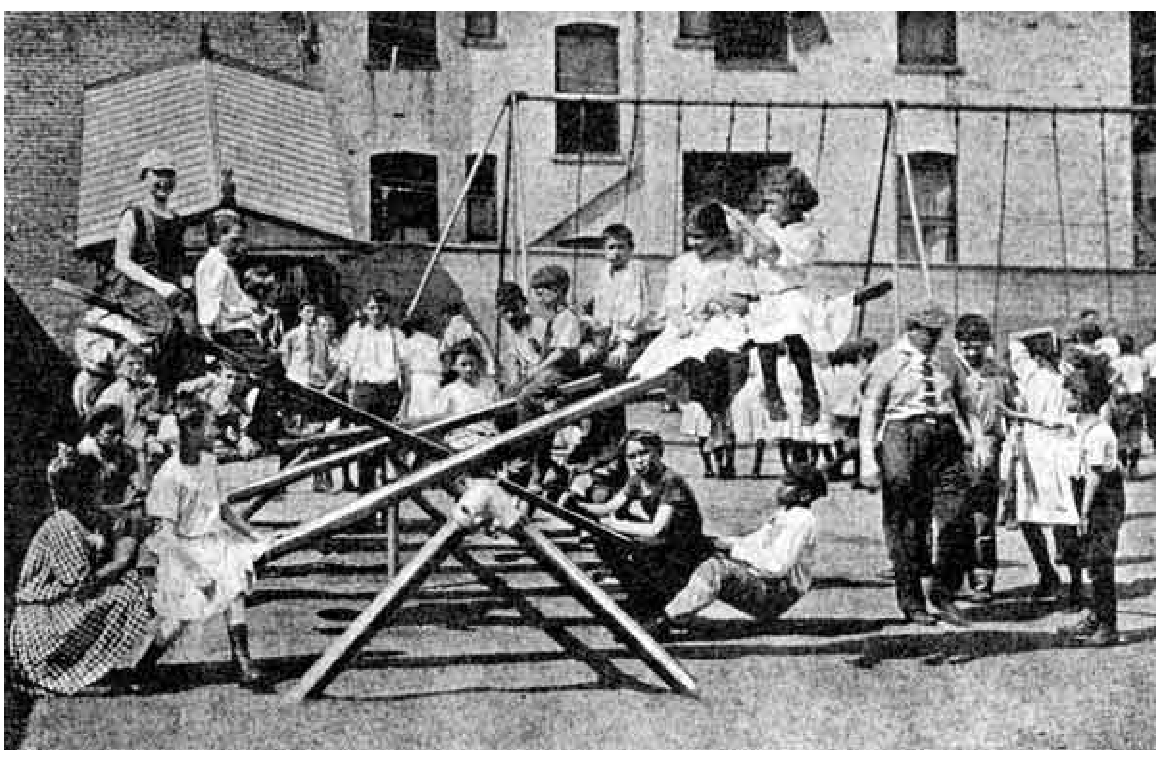

Figure 2.1 An early schoolyard playground (Mero 122)

Free play or recess involved children playing on a usually enclosed lot or yard on fixed apparatus (Figure 2.1). The play equipment was usually made of the sturdiest materials (often iron) available and might include see saw, swings, horizontal bars or ladders, and other climbing apparatus. An adult or play leader supervised the children and sometimes led organized games. Though the play lot developed during the early 1900's, many schoolyards today still resemble those earliest playgrounds.

Some playgrounds, however, advanced beyond the earliest outdoor gymnasium concept. The adventure play movement originated in Emdrup near Copenhagen in 1943 (Bengtsson Adventure 15). C. Th. Sorenson suggested the idea in his work *Open Spaces for Town and Country* in 1931, but the play leader of Emdrup, John Bertelsen, brought the concept to life. Arvid Bengtsson and Lady Allen of Hurtwood publicized the importance of creative, lively, adventurous play spaces for children throughout Europe. The adventure playground consists of various loose materials, including wood, tires,

Figure 2.2 Adventure playground (Bengtsson Adventure 71)

rope, water, and earth, which children can manipulate into a desirable environment under the supervision of a play leader. The result invariably includes clubhouses, towers, kitchens, and genuine communities within the playground (figure 2.2). Children in adventure playgrounds, though not exposed to nature, benefited socially, intellectually, and physically from a freer and more flexible play environment.

M. Paul Friedburg and Richard Dattner began creating stimulating and malleable play environments in the United States in the 1960's. The American "natural play" movement of this era grew out of the European adventure play movement. The creatively designed playgrounds, often located in large cities, serve as more than places for physical education and development. By this time, it was generally recognized that children's development included social, psychological, and intellectual changes as well. Designers began to create spaces to encourage children's development on all levels. These playgrounds (figure 2.3) contained changes in topography, water features, moving parts, and some natural materials. Even with the introduction of malleable and moving

Figure 2.3 Innovation in children's play in the 1960's (Friedberg 37)

parts including sand and water, play spaces only imitated mountains, streams, and tunnels, which remained artificial.

The innovative work of designers like Dattner and Friedburg led to modular wooden play systems, originated by Sonja Johansson in New York in the 1960's and commonly used in the 1970's and 1980's (Dannenmaier 60). The modular system was adaptable to various sites, had some moving (but attached) parts like tire swings and spinning wheels, and used mostly natural materials. Today, pre-fabricated modular play equipment is common, but may be constructed of a variety of materials. This apparatus may be organized in various configurations to stimulate children's bodies and imaginations, but often has little relation to nature.

Modern Play Environments

Children's safety is a major concern for parents and playground designers. Americans' fondness for litigation frightens playground designers from innovating, leading to a perpetuation of older style playgrounds (Bennett 24). Though children's welfare has rightly always been a driving force behind the play movement, safety concerns now hamper the creativity and originality of playground designers.

Figure 2.4 An "educational" playground (Perello 75)

In today's crowded urban environment, the school or public park hosts most play spaces for children. These sites contain gymnasiums and exercise equipment along with outdoor play equipment and apparatus. The majority of playgrounds contain traditional equipment such as jungle gyms, steel swings, and slides (Brett, Moore, and Provenzo 9).

Play in the streets and leftover spaces is a traditionally urban phenomenon. While such play has always been unstructured and unsupervised, it has not always been as dangerous as traffic and crime makes it today. Even the haven of the vacant lot and the local corner is less frequently available to children in the urban landscape than in years past. Children lack the interaction with adults and the challenge and freedom of moving alone through the city. Though less than an ideal play environment, even the urban street is diminished today as a safe space for children.

Though essentially every public school includes a much-needed playground, these existing spaces suffer from a number of problems. Most of the play equipment, although sometimes colorful, is sterile and pre-fabricated. Natural areas such as woods, creeks, and open lawn are rarely found on public sites, as urban open space becomes a premium as cities grow. The traditional playground often found at school ignores many aspects of children's development, and is the site of more injuries than other types of playgrounds (Brett, Moore, and Provenzo 11). Accidents on traditional play equipment have resulted in litigation since 1915, when schools in Washington state removed much play equipment after paying damages to the parents of a boy injured falling from a swing (Curtis 89).

In general, today's play environments occupy specific spaces in the community alongside schools or in corners of public parks. Play spaces can and should be integrated into the urban fabric and be places for multiple users and activities. Christopher Alexander's *A Pattern Language* suggests the creation of children's homes: places for children and families to gather that act as a second home within the community (Alexander 427). Children's social and emotional development depends on interaction with adults and all other parts of the community (Rivkin 14), including plants and animals. This interaction can take place only if children are allowed to experience different parts of their environment on their own terms, through play.

Educational Opportunities

The concept of children learning through play is not a new one. The researcher Piaget introduced his theory of developmental stages reached through play and interaction in the 1920's. There are many opportunities for children to advance psychologically, physiologically, socially, and intellectually while playing. Many early teaching techniques use indoor play as a means to engage children while learning. The Montessori method encourages children to learn directly from interacting with their environment and from each other (www.montessori.edu).

Recent Innovations

The merging of education and play can be seen in the recent reintroduction of "nature" into urban schoolyard habitats. Parents and educators are concerned about the lack of nature in urban and suburban environments for children, and some have responded by the addition of outdoor classrooms for environmental education. For instance, the National Wildlife Federation sponsors the Schoolyard Habitats program to restore access to natural spaces to children. Though sometimes limited to bird houses or vegetable gardens, this program encourages schools to create learning environments that are both wildlife habitats and exciting places to teach and learn.

Other exciting play projects include natural materials and landscapes as play environments. An infant garden at the Early Childhood Lab at the University of California-Davis uses earth mounds, sand, and plants to engage very young children in a safe outdoor environment. This project offers an alternative to less interesting paved and fenced play areas and promotes development (Leccese 65). The Environmental Yard (see case studies in Chapter four) in Berkeley, California extends educational space into the outdoors at the Washington Elementary School. Robin Moore created a learning and play space including plants, play equipment, pond, and stream from a traditional asphalt play lot. This exciting space has encouraged creativity and exploration since its beginning in the 1970's. The 1996 playground addition to the New York Hall of Science beginning in the 1970’s. The 1996 playground addition to the New York Hall of Science is a colorful and interactive play space for children. Though it does not use natural materials, the play space continues the educational aspect of the museum while offering accessibility to challenging play elements for all children (Bennett 24). Many urban parks offer “spraygrounds” for children to play with water in man-made environments, such as Centennial Olympic Park in Atlanta, Georgia.

These innovative play spaces break the mold of traditional playgrounds and show the potential for play and learning in exciting and natural landscapes. They also represent a variety of ways in which play environments may develop in the future. The following is a short list of organizations involved in improving children’s play and educational environments:

- MIG Communications
- International Association for the Child’s Right to Play
- Planet Earth Playscapes (www.earthplay.net)
- National Wildlife Federation
- Learning through Landscapes.

CHAPTER 3

URBAN HYDROLOGY

This chapter explores the basic concepts of hydrology and the problems of urban hydrology. The purpose of this exploration is to understand the relationship between cities and streams, and more specifically, how urban development negatively impacts water and the environment. It will also introduce some common practices of stream restoration.

This thesis often uses the term “urban stream.” The phrase has no specific, widely accepted definition. The meaning of “urban stream” here is simply any small waterway that is located in a densely populated, highly built, or significantly altered (by humans) environment.

Hydrology Basics

The hydrologic cycle is a natural process of water movement. Undisturbed natural systems work to filter and distribute water into streams and rivers. Water travels through the air, soils, and oceans in a complex repeating system.

Streams as a part of the hydrologic cycle are dynamic and shaped by the moving water in their banks. They rise from springs and groundwater and move water into rivers. Though streams are dynamic systems, they reach stability at a level of equilibrium, defined as a state where discharges of water and sediment equal inflows to the system (Ferguson 324). Even at equilibrium, a stream’s features may change over time or during high flow events.

Streams typically contain a variety of habitats. Deep, quiet pools alternate with shallow, coarse riffles. The channel banks may contain riparian vegetation. Organic debris in the stream channel offers another type of habitat (Beschta 369). This variety of features is caused by the natural process of energy dissipation in the form of scour, fill, aggradation, degradation, bank cut, and deposition (Beschta 370). These and other dynamic processes cause changes in interrelated stream characteristics: longitudinal profile, channel sinuosity (meanders and point bars), the roughness of streambed and bank, and the hydraulic radius of the stream (Beschta 377).

Problems of Urban Hydrology

Man has been changing and impacting streams throughout the history of cities. As humanity's population has expanded and cities grown, the damage to streams and waterways has increased. Urbanization impacts stream systems in many negative ways.

The problems of urban hydrology are many and well known (Ferguson 325, Spirn 129). Increased erosion and runoff lead to higher sediment levels. Impervious surfaces in urban areas cause higher peak discharges and more frequent and intense flooding than in natural systems where storm water is allowed to infiltrate into the soil.

Typically, streams in urban environments are channelized or piped, especially those of a lower order or smaller size. This practice is an attempt to control flooding, but often adds to the problem downstream by increasing water velocity and removing the stream from its natural dynamic equilibrium state. When streams are not put into man-made channels or culverts, increased floods destabilize the stream system and cause channel incision or widening. Enlarged channels and bank failure lead to cycles of aggradation and degradation of sediment and other materials.

Because water moves faster through the urban system, streams with higher flood levels also suffer from lower base flows. Lack of infiltration into the soil leads to less groundwater and a lowered water table, meaning that there is less water available to serve urban environments (Spirn 138). At the same time, water imported from outside the watershed through pipes may enter the stream system through irrigation runoff or treated wastewater effluent (Paul and Meyer 18).

Increased runoff also means a higher concentration of urban pollutants. This pollution can occur in many forms. For instance, increased nutrient levels, such as phosphorous from fertilized and irrigated lawns, may lead to high amounts of algae. Biological contaminants, often fecal coliform and/or *E.coli*, appear in streams due to leaky sewer lines, combined sewer overflow systems, deteriorating septic systems, and other non-point sources. A variety of other substances, including metals, other ions, and organic materials may contaminate urban streams. These pollutants add to the changed stream morphology and combine to create a highly disturbed ecosystem.

A damaged stream can be classified as unhealthy. It will not meet these criteria of health: openness, self-regulation, storage, diversity, and relevance or internal interaction (Snyder 22). The criteria as applied to streams add up to a functioning system that is: open to the movement of water and sediment; reacts to changes in the watershed; stores water and sediment in the channel and floodplain; contains a diversity of vegetation, habitats, materials, and organisms; and has interacting components. In short, the stream ecology is compromised due to urbanization. This damage is evident in lower abundance and diversity of fish, invertebrates, and other organisms. The decreased health of the stream is caused mostly by increased impervious surfaces of urban environments and streams altered by humans. Another result of the degradation of the stream is its reduced aesthetic quality.

Benefits of Improved Stream Processes in Urban Environments

Restoration and protection of urban streams have obvious benefits, given the preceding discussion. Greater flood control and increased amounts of available groundwater are two major advantages of natural stream systems. Allowing the filtration of water through natural processes also reduces pollution in streams, rivers, and drinking water. A more natural stream has a more stable temperature, cooler in summer and warmer in winter, which adds to the health of the ecosystem.

In addition to improved ecology, restored or naturalized urban streams offer many opportunities for active and passive human use. A stream located in a schoolyard or in a nearby park can be an educational tool for teachers, serving as an outdoor laboratory. A local stream provides recreational possibilities for parents and children in the form of walks, fishing and exploration. The sounds, smells, and sights of a neighborhood waterway are aesthetically pleasing for everyone.

Common Current Practices in Urban Stream Restoration

It is impossible to fully restore an urban stream to a pre-disturbed state. The purpose of stream restoration is actually often more of a rehabilitation or revitalization. This means that the health or ecology of the stream is improved to function within the urban environment. The term "daylighting" is often used to describe the process of reconstructing a piped (underground) stream to a healthier state above the ground.

The restoration of a disturbed stream requires a complete restoration plan to ensure long-term success. This plan may take one of three general approaches. The first and least invasive involves no action. In this approach, the disturbing factors to the stream are removed, and the environment is left alone to "heal itself." A more moderate

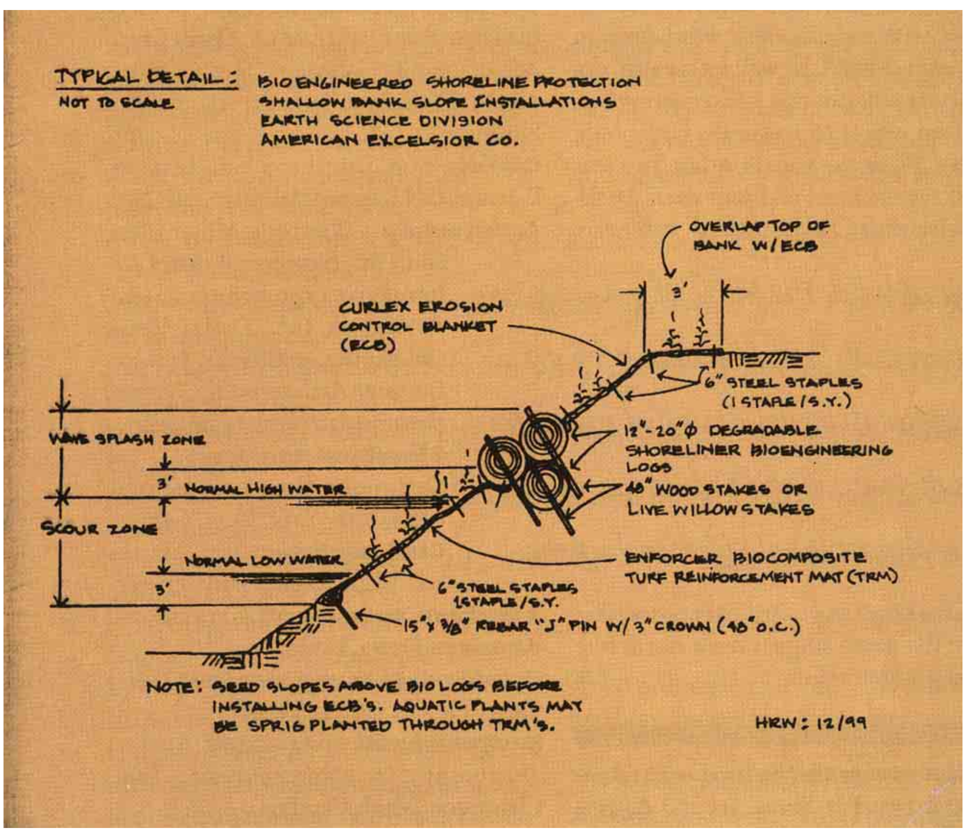

Figure 3.1 Bioengineering construction detail (Owens 80)

approach of management involves modification or removal of the disturbing factors, but allows continued stream use during the recovery period. The manipulation approach significantly changes the conditions of the stream to improve its health. (Stream Corridor Restoration A-1)

Types of stream restoration are arranged along a spectrum of size from large to small. Protection of the entire watershed, from preserving woodland to repairing damaged sewer pipes, is restoration at a large scale. Moving toward the smaller end of the spectrum, cities and groups may reserve part or the entire stream corridor as a form of restoration. Improving and manipulating the stream channel, or geomorphic restoration, is another approach to stream improvement. Within the channel, the stream bank itself may be treated for stabilization and improved vegetation (see next section for specific examples). Other improvements may be made not only along the banks, but also within the stream, such as grade control measures like weirs or check dams. Finally, the water itself may be physically treated to remove sediment and improve quality.

Figure 3.2 Stream bank restoration in progress (Owens 92)

<u>Stream Renovation Methods</u>

As stream renovations become more common, certain methods of design and construction evolve. This section lists and defines some of these techniques. Some of them will recur in the case studies of chapter four and the design application in chapter five. The following information comes from the <u>Stream Corridor Restoration</u>.

Analysis of upstream geometry/stream meander restoration – transformation of a straightened stream into a meandering one to reintroduce natural dynamics, improve channel stability, habitat quality, aesthetics, and other stream corridor functions or values.

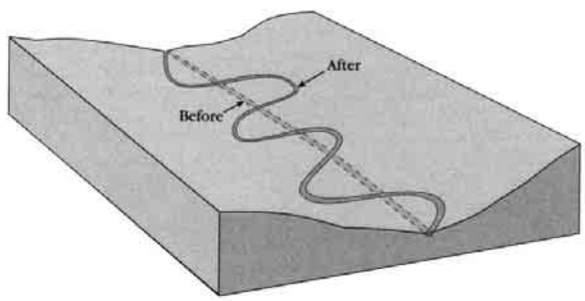

Figure 3.3 Stream meander restoration

Native plantings/bank shaping and planting – regarding stream banks to a stable slope, placing topsoil and other materials needed for sustaining plant growth, and selecting, installing and establishing appropriate plant species.

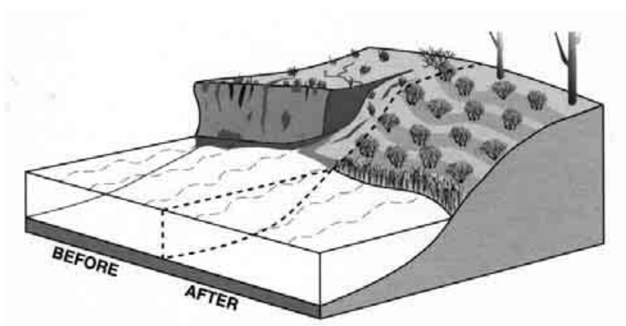

Figure 3.4 Bank shaping and planting

Large rocks on outside of meanders/boulder clusters – groups of boulders placed in the base flow channel to provide cover, create scour holes, or areas of reduced velocity.

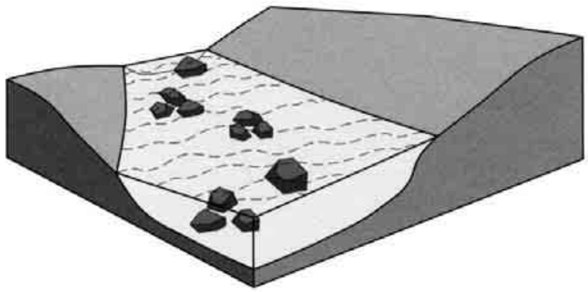

Figure 3.5 Boulder clusters

Live Fascines – dormant branch cuttings bound together into long sausage-like, cylindrical bundles and places in shallow trenches on slopes to reduce erosion and shallow sliding.

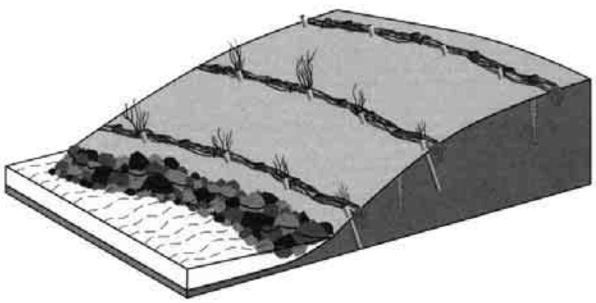

Figure 3.6 Live fascines

Brush layering/mattresses – combination of live stakes, live fascines, and branch cuttings installed to cover and physically protect stream banks; eventually to sprout and establish numerous individual plants.

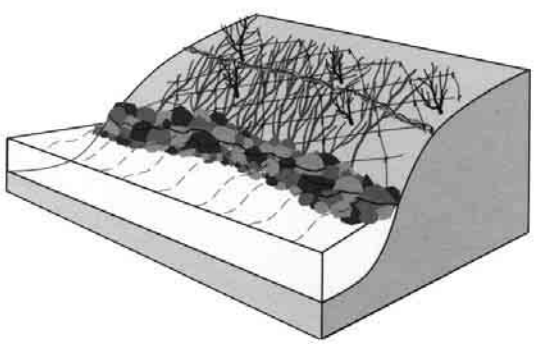

Figure 3.7 Brush mattresses

Pole cuttings/live stakes – live, woody cuttings which are tamped into the soil to root, grow, and create a living root mat that stabilizes the soil by reinforcing and binding soil particles together, and by extracting excess soil moisture.

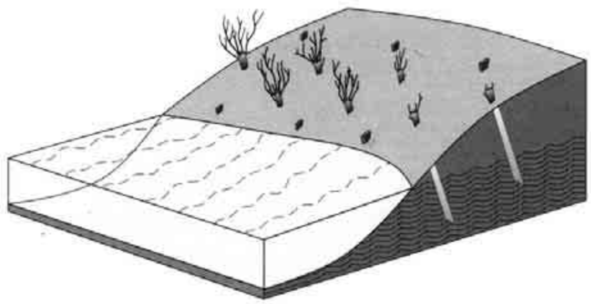

Figure 3.8 Live stakes

Biodegradable erosion control fabric/coconut fiber roll – cylindrical structures composed of coconut husk fibers bound together with twine woven from coconut material to protect slopes from erosion while trapping sediment that encourages plant growth within the fiber roll.

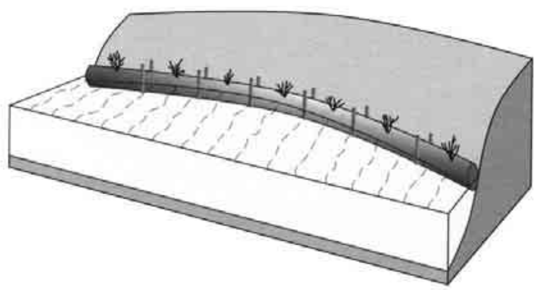

Figure 3.9 Coconut fiber roll

Upstream "v" dams/fish passages – any one of a number of instream changes that enhance the opportunity for target fish species to freely move to upstream areas for spawning, habitat utilization, and other life functions.

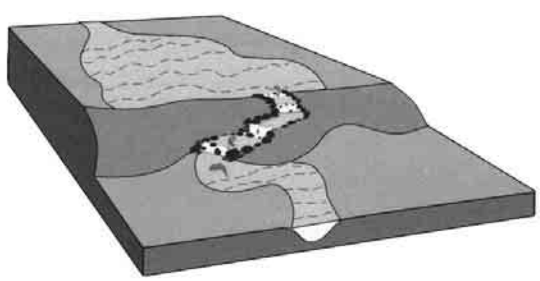

Figure 3.10 Fish passages

Angled boulder dams/weirs or sills – log, boulder, or quarry stone structures placed across the channel and anchored to the stream bank and/or bed to create pool habitat, control bed erosion, or collect and retain gravel.

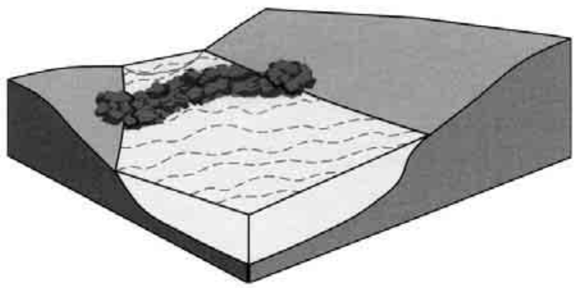

Figure 3.11 Weirs or sills

Boulder deflectors/wing deflectors/double wing deflectors – structures that protrude from either stream bank but do not extend entirely across a channel. They deflect flows away from the bank, and scour pools by constricting the channel and accelerating flow.

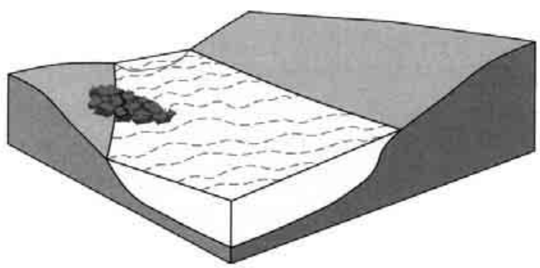

Figure 3.12 Wing deflectors

CHAPTER 4

CASE STUDIES AND PATTERN IDENTIFICATION

Case Studies

The following case studies were chosen to illustrate how play is presently occurring in restored streams or other natural areas in the urban environment. In urban areas of Berkeley, California, parents and designers have reclaimed several natural environments for children. Strawberry Creek and Blackberry Creek are wonderful examples of relatively low budget stream daylighting projects, and the Environmental Yard at Washington Elementary School has provided ecological play and education since the 1970's. A larger scale stream daylighting and revitalization project in Boulder, Colorado, offers an example of stream improvement for recreation, transportation, and ecological reasons.

These case studies illustrate various methods of improving streams in urban environments. These improvements are geared toward ecology and stream health; except for the Environmental Yard in Berkeley, California, they do not focus entirely on either recreation or play for children. The question of this thesis is how designers can plan to better accommodate play in urban stream environments. The patterns emerged from the case studies and are introduced as means of classifying and specifying children's play in streams and water environments.

Berkeley, California

Strawberry Creek in Berkeley, California is both literally and figuratively a groundbreaking stream revitalization project. Daylighting of streams has become an accepted practice today, but in 1982 the transformation of abandoned rail yard and buried creek into a vibrant community park was almost unheard of. It was then that the City of Berkeley landscape architect, Douglas Wolfe, proposed uncovering two hundred feet of the culverted stream and making it the focus of a four acre park. Despite city officials fearful of creating an unsafe, trash-filled flood hazard, the Berkeley Parks Commission eventually approved the project after a remarkable amount of positive public support.

Figure 4.1 Strawberry Creek in 1991, seven years after installation began (Powell 47)

The grass-roots movement to improve stream ecology and recreational potential developed into a popular park with many amenities. The potential for play is high, given its neighborhood location, popularity, and close proximity to schools.

Table 4.1 Strawberry Creek Statistics (Charbonneau 294, Pinkham 18, Powell 47)

Designer	Douglas Wolfe, City of Berkeley
Purpose	Part of an urban park
Year of construction	1984 (later phase on University of Berkeley not discussed here
Total cost	$50,000 (out of total $580,000 park budget)
Cost per linear foot	$250
Linear feet of stream	200
Current uses	Increased property values Inspiration and pattern for other projects Heavy public use, including children High school students employed for creek maintenance
Potential for play	Public school use • Running stream • Malleability and manipulation • Pond edge • Bridge
Methods of construction	Daylighting Re-use of concrete culvert as rubble, riprap, and steps Designed for 100-year flood event Analysis of upstream geometry to determine stream bed Fill dirt used to create hills and swales Native plantings for soil stabilization (bioengineering)

Blackberry Creek is another stream revitalization project in Berkeley, this time located in a schoolyard. Thousand Oaks Elementary School is now home to an outdoor environmental education classroom and laboratory. The school's park also includes a picnic area and tot lot. The success of the project is also due to improved flood control of the previously troublesome creek through the construction of four shallow rock weirs. Douglas Wolfe was again involved in the daylighting project, this time as a private landscape architect rather than a city employee.

Table 4.2 Blackberry Creek Statistics (Pinkham 22)

Designer	Wolfe Mason Associates (includes Douglas Wolfe)
Purpose	Environmental education classroom and lab Flooding improvement Improved recreational park Structural upgrades to school after earthquake
Year of construction	1995
Total cost	$144,000 (out of total ~$200,000 total Urban Stream Restoration Program)
Linear feet of stream	250
Cost per linear foot	$576
Current uses	Part of Thousand Oaks Elementary School, a magnet school focusing on ecology Includes tot lot on site Includes pedestrian bridge, creek side path, picnic area
Potential for play	On elementary school grounds • Running stream • Malleability and manipulation • Bridge
Methods of construction	Daylighting Analysis of upstream geometry to determine stream bed Analysis of old aerial photos to determine meanders Four shallow rock weirs Erosion control methods: • Large rocks placed on outside of meanders • Fascines • Brush layering • Pole cuttings • Biodegradable erosion control fabric • Native dogwood planting

Environmental Yard, Berkeley is a unique schoolyard habitat project begun in the 1970’s. The goal of the project was to “transform” a paved play yard into a natural play and learning space (see figures 4.2 and 4.3 for site conditions before and after construction). Though the site did not contain a culverted or degraded stream, the built environment includes various water features, including a “river,” all designed especially for children (see figure 4.4). This project is unique because children, parents, and the community at large all had a hand in its conception and implementation. The Yard was dismantled in the late 1990's to make way for other play equipment.

Figures 4.2, 4.3, 4.4 Environmental Yard before and after (Dannenmaier 60)

Table 4.3 Environmental Yard Statistics (Dannenmaier 60, Moore, Natural 37)

Designer	Robin Moore (MIG Associates)
Purpose	"To transform a typical asphalted urban schoolyard into a democratic learning and playing space by engaging the children, parents, teaching staff, and surrounding community in the transformation process" (Moore, Natural 117)
Year of construction	1970's (construction began 1972)
Total cost	Unknown, due to labor and materials donations
Linear feet of stream	Approximately 50 feet plus two small ponds (all man-made) within the half-acre Natural Resource Area
Current uses	Informal play Outdoor classroom Organized recreation programs
Potential for play	Located on elementary school grounds • Running stream • Swimming hole • Malleability and manipulation • Pond edge • Stepping stones • Waterfall
Methods of construction	Annual community participation through "Yardfest"

Boulder, Colorado

Boulder Creek in Boulder, CO is a larger scale stream de-channelization project including pedestrian and bicycle trails, improved fish habitat and riparian wetland, and flood control measures. Planning for the project began as early as 1910, when Frederick L. Olmsted, Jr. created an open space plan that included stream preservation. The project gained momentum in the 1970's, when several plans included the stream corridor as an alternative transportation route. Strong community support led to the Boulder Creek Corridor Plan in 1984. This large public project was funded from various public and private sources and is a well-used recreation and transportation corridor. It includes a variety of recreation areas, including kids ponds and many accessible areas of the creek.

Table 4.4 Boulder Creek Statistics (Windell, Rink, and Lacy 279)

Designer	Design guidelines by Boulder Parks and Recreation Dept.
Purpose	Provide an off-street transportation system Preserve and enhance fish habitat and riparian wetland Expand recreational use Protect existing water rights Maintain and improve the creek flood-carrying capacity
Year of construction	Begun 1984
Total cost	$3.5 million
Cost per linear foot	$138
Linear feet of stream	4.8 miles
Current uses	Ten foot wide bicycle and pedestrian trail 8 footbridges 2 sculpture parks 8 pocket parks for passive and active recreation 4 major and various minor kayak chutes and fish ladders
Potential for play	Project includes two "kids ponds" for fishing and recreation • Swimming hole • Pond edge
Methods of construction	Fish habitat improvements: • upstream "v" dams • angled boulder dams • boulder deflectors • "s" dams • double wing deflectors

Patterns

The topics of urban stream revitalization and children's play overlap. The intersection of these subjects is the topic of this thesis. Understanding the correlations between the forms of children's play with water and the forms of stream restoration practices results in identification of archetypal forms for the designer. Opportunities for recreation, education, and improved stream health exist in the expansion of natural systems in the urban environment. Children in particular benefit from the revitalization of urban streams as a landscape for play, learning, and exploration.

Play with water can be a powerful medium for children's learning and development. The experiences with water, either natural or unnatural, impact a person's appreciation and understanding of our world. These aquatic interactions come in a variety of forms. In more rural or natural environments, children may be freer to explore and experiment with water in the form of streams. These encounters may be classified into a few basic types. The following list attempts to identify the most basic and common of these formative childhood experiences with water in the natural and accessible form of a stream.

Figure 4.5 Harbor (Messervy 74)

In *A Pattern Language*, Christopher Alexander and others develop a system of analyzing and classifying well-designed spaces into patterns. The book uses iconography, sketching, and photography to portray each idea. Julie Moir Messervy creates archetypal spaces in her gardens such as "harbor," "island," and "the cave" (Messervy 74). These concepts are embodied using simple, expressive sketches (see figure 4.5). Robin Moore lists many spaces for play with water in Natural Learning, including "curving creek," "marsh," "peninsulas," and "soft, muddy edges."

Using these and other works as examples of classification methods combined with my own research, personal experience, and observation, the following list of patterns of play with water evolved. I developed the sketches and verbal descriptions to capture the essence of each pattern.

Running stream

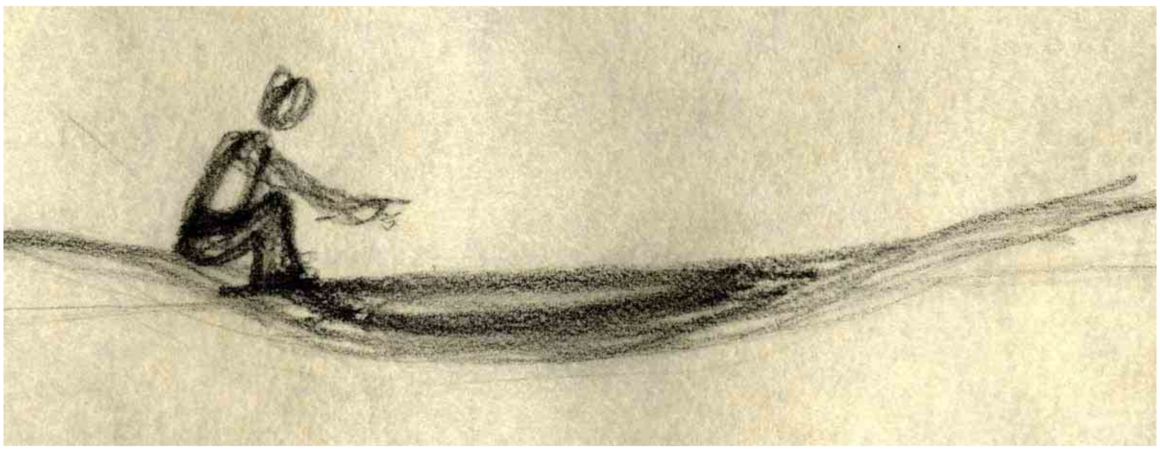

Figure 4.6 Running stream

- shallow moving water, sometimes rapid
- meandering stream forms
- floating objects along the stream
- wading, sitting in the water
- reflected sunlight, movement of light
- sound of rippling
- gravel bottom, smooth stones sliding
- discovering other life forms

Swimming hole

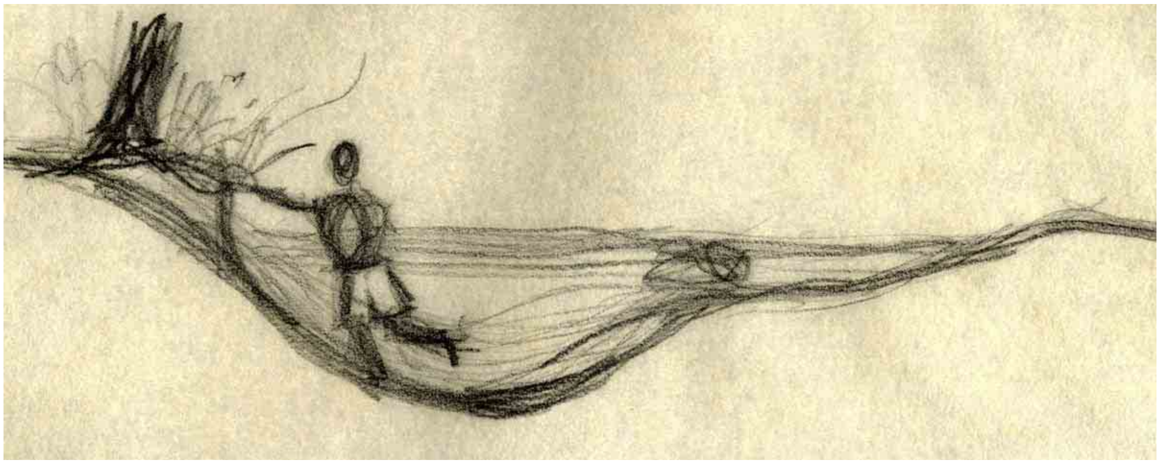

Figure 4.7 Swimming hole

- deep still water
- immersion
- cool or cold water
- shade, darkness contrasts sunlight
- quiet
- moss, roots, rich organic life
- underside of banks
- aroma of decomposition
- fishing

Manipulation

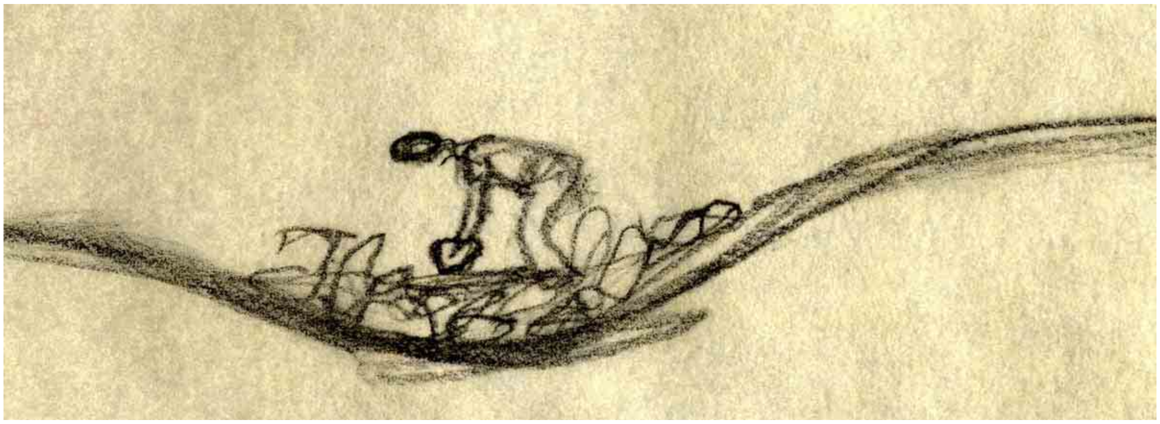

Figure 4.8 Manipulation

- mud, sand, erosion of stream bank
- building and destroying dams, converting still water to moving water, kinetic energy
- heavy, substantial, slippery stones
- hunting salamanders, crayfish, insects under stones
- power, impersonal nature of moving water

Pond edge

Figure 4.9 Pond edge

- plants, animals, life
- wetlands
- soft mud, green algae, pale grasses
- bubbles of underground organisms
- barefoot, mud between toes
- aroma of life and decay

Stepping stones

Figure 4.10 Stepping stones

- crossing water
- thrill and danger of slipping, falling
- contrast of being above vs. in the water, dry vs. wet
- building of bridge, path of stones
- island
- view from within stream banks, up and down channel

Waterfall

Figure 4.11 Waterfall

- sliding
- cold water
- mixture of air and water, bubbles
- motion, force of falling water

CHAPTER 5

DESIGN VIGNETTES: THE APPLICATION OF PATTERNS

Goals and Objectives of Design

The purpose of this chapter is to identify specific ways to create engaging and exciting places for children to play with water. These play spaces are based on naturally occurring features of streams and my own and others' childhood interactions with water. In order for children to fully immerse themselves in play and learning, they must be allowed to access the water using all of their senses: touch, taste, smell, sight, and sound. For the child to thoroughly experience a stream, he must be able to get near, on, in, and under the water (Yokoyama 36). Access to water in a well-designed play space provides a safe and comfortable environment for the child to explore, create, and take risks, all of which he needs for development (Stine 28).

The design criteria listed for each pattern are based on the characteristics of each pattern from chapter four, and relate to both the biotic habitats found in natural streams and current practices for stream revitalization discussed in chapter three. After stating the general design criteria for each pattern, the designs will be applied to a specific site. The purpose of the design application is to give an example of how the patterns may be fitted together to create a more natural play space from a damaged urban stream.

Design Criteria and Graphic Portrayal of Designs

Table 5.1 Design Criteria

Running stream – relates to riffles, fish passages	
Materials	rocks, pebbles, sand
Depth/width/shape of bank and channel	very shallow and fairly flat (causes turbulence for sound and light), meandering with large rocks placed on outside of bends, varying width
Speed/movement	rapid, especially where narrow
Vegetation/organisms	moss on rocks, grassy open banks
Play activities	wading, splashing, floating objects

Swimming hole – similar to pools	
Materials	large rocks, sandy bottom
Depth/width/shape of bank and channel	deep and wide, outside main flow of water, overhanging or steep bank, deep water is colder, smooth water for reflection, rounded bowl shape for enclosure
Speed/movement	slow
Vegetation/organisms	moss on rocks, overhanging trees, rich soil
Play activities	swimming, jumping, swinging on vegetation, floating, thinking

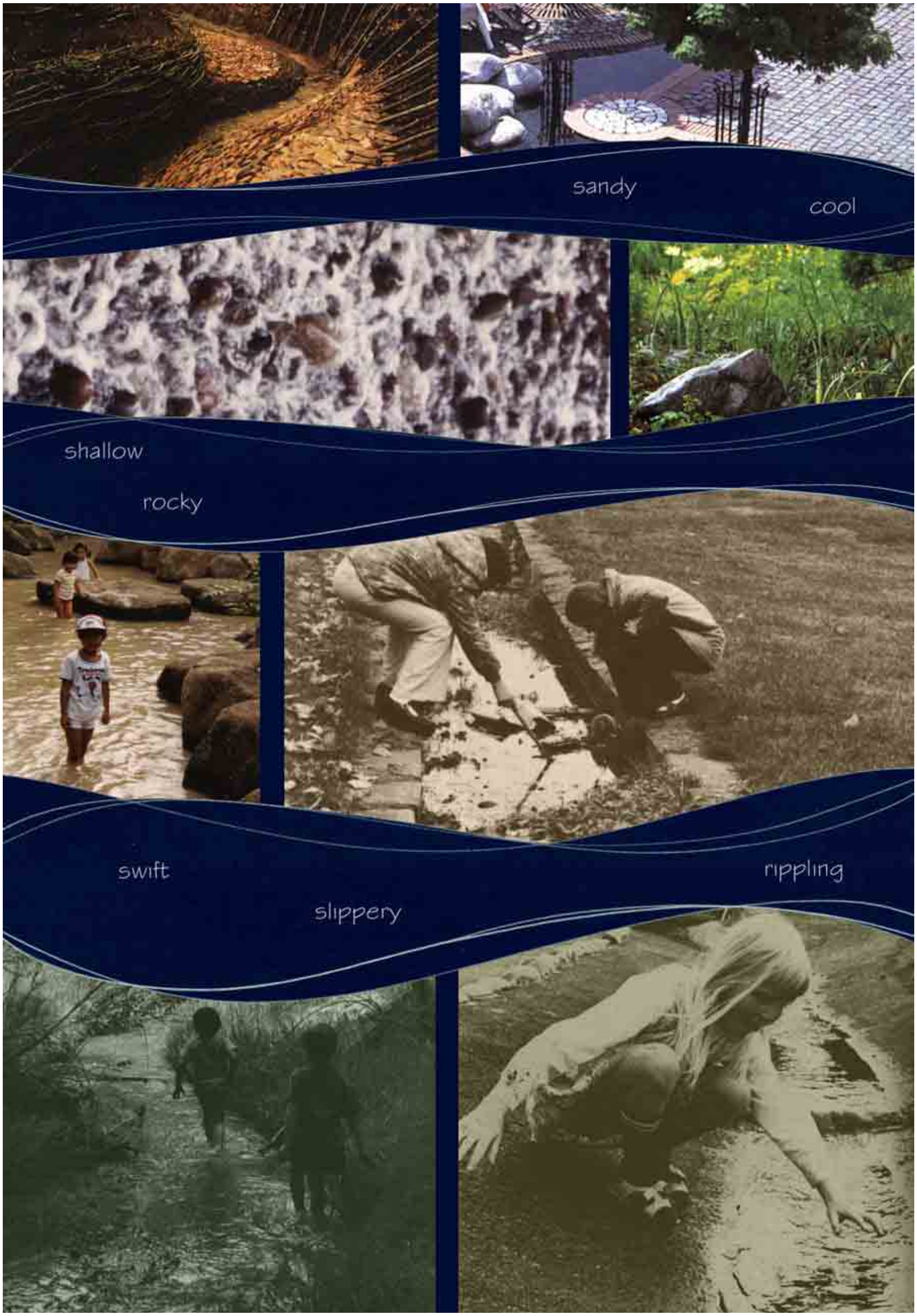

Figure 5.1 Running stream (Hammatt 36, Crandell 104 & 108, Yokoyama 49& 52, Moore Childhood's 154, Nabhan and Trimble iv, Bengtsson Child's Right 72)

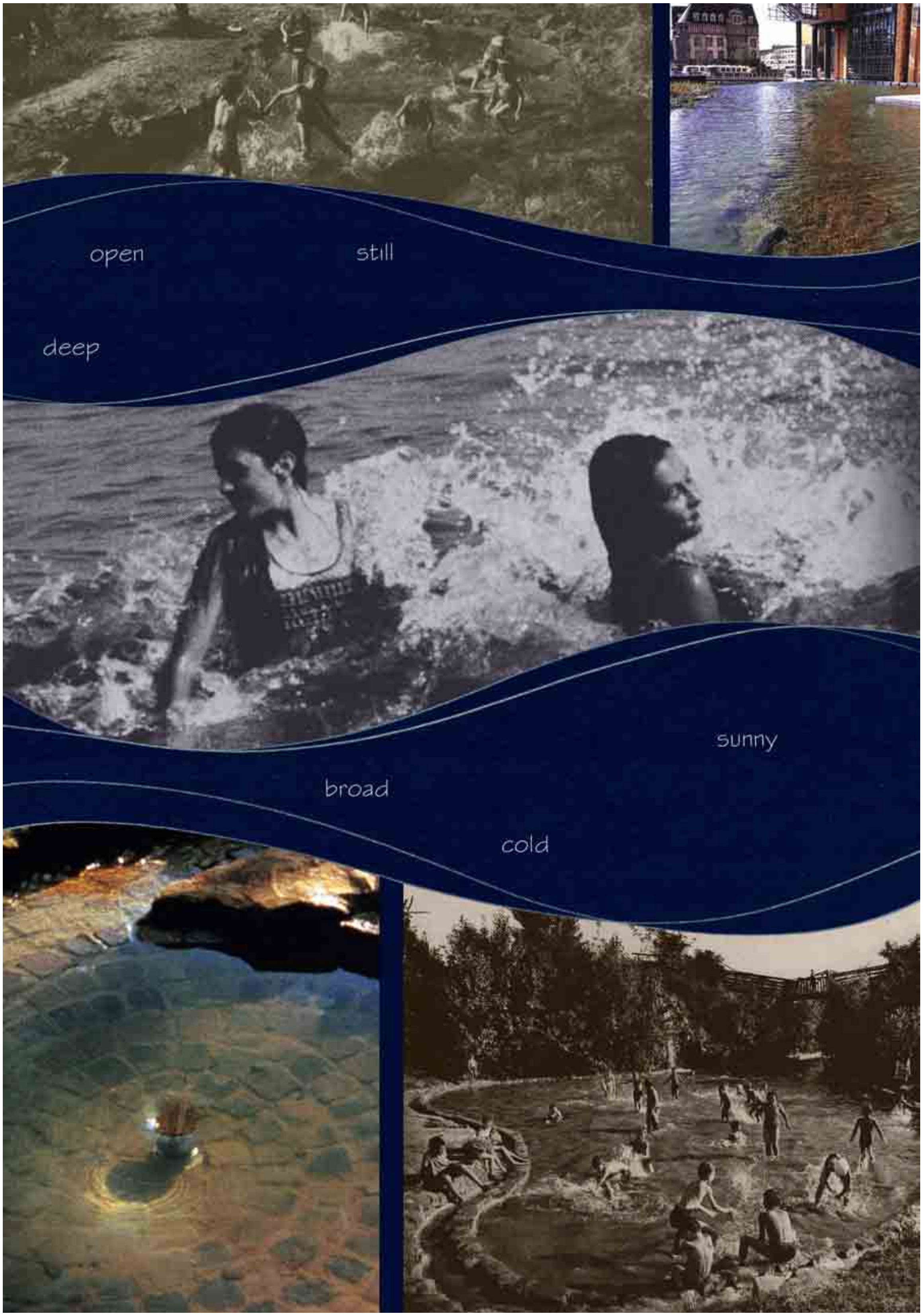

Figure 5.2 Swimming hole (Crandell 104 & 108, Friedberg 14)

Manipulation - this pattern can be applied over most of the others, but plans should be made for provision of materials and less sensitive microclimate for children's play.	
Materials	sand, pebbles, rocks, plants and leaves, found objects, also include tools such as pumps, buckets, and shovels
Depth/width/shape of bank and channel	varying, with some narrow places and soft soil
Speed/movement	fairly rapid to allow appreciation of kinetic energy
Vegetation/organisms	variety of grass, shrubs, trees for use and variety of materials
Play activities	damming, digging

Pond edge (riverbank) – like oxbow lake, delta	
Materials	mud, sand
Depth/width/shape of bank and channel	gently sloping, wide
Speed/movement	moderate, lapping at shore
Vegetation/organisms	many various plants, fish, and insects
Play activities	wading, fishing, sitting, digging, look boxes

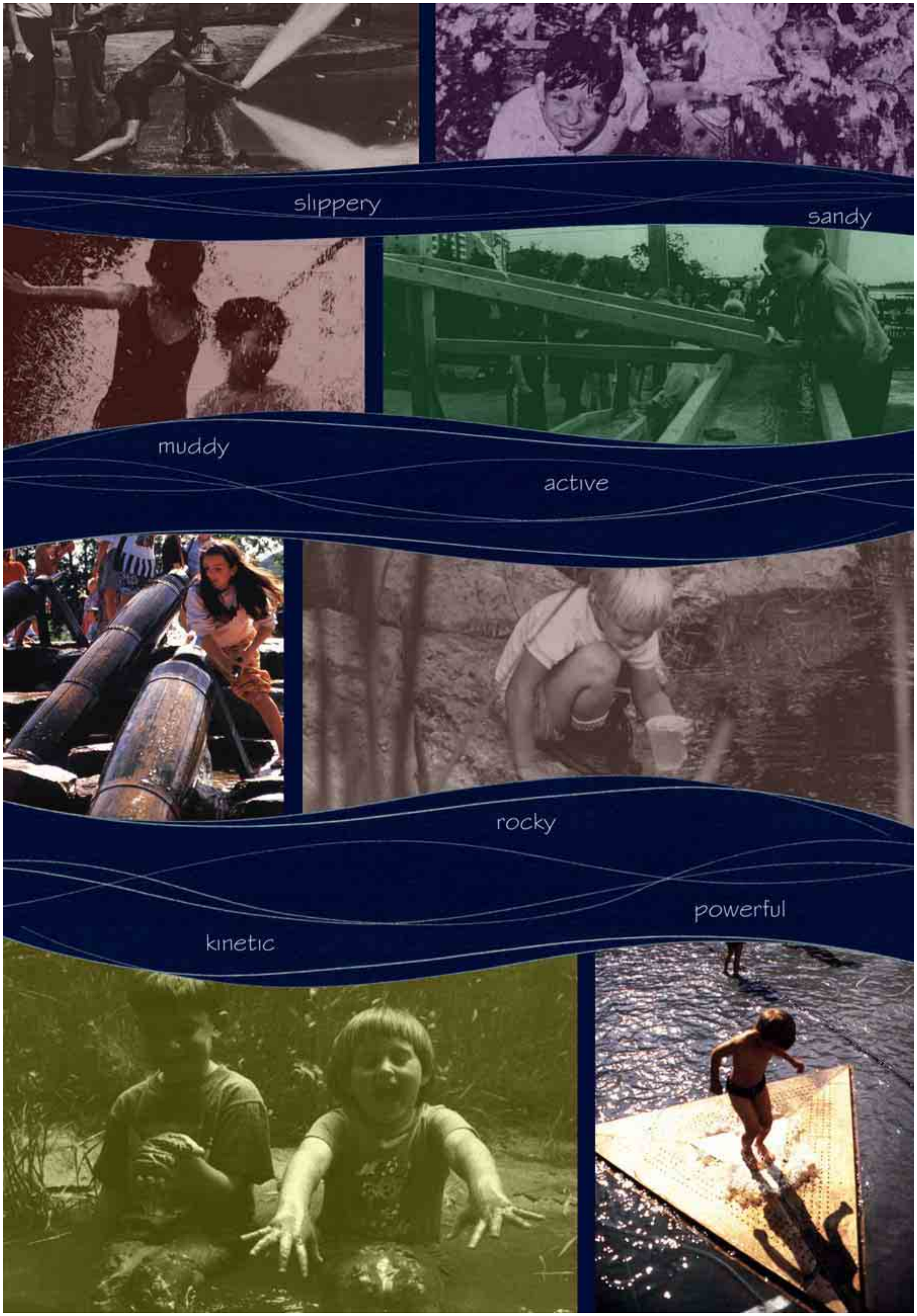

Figure 5.3 Manipulation (Dattner 10, 19 & 55, Brett, Moore and Provenzo 83, Crandell 106, Rivkin 66, Nabhan and Trimble 53)

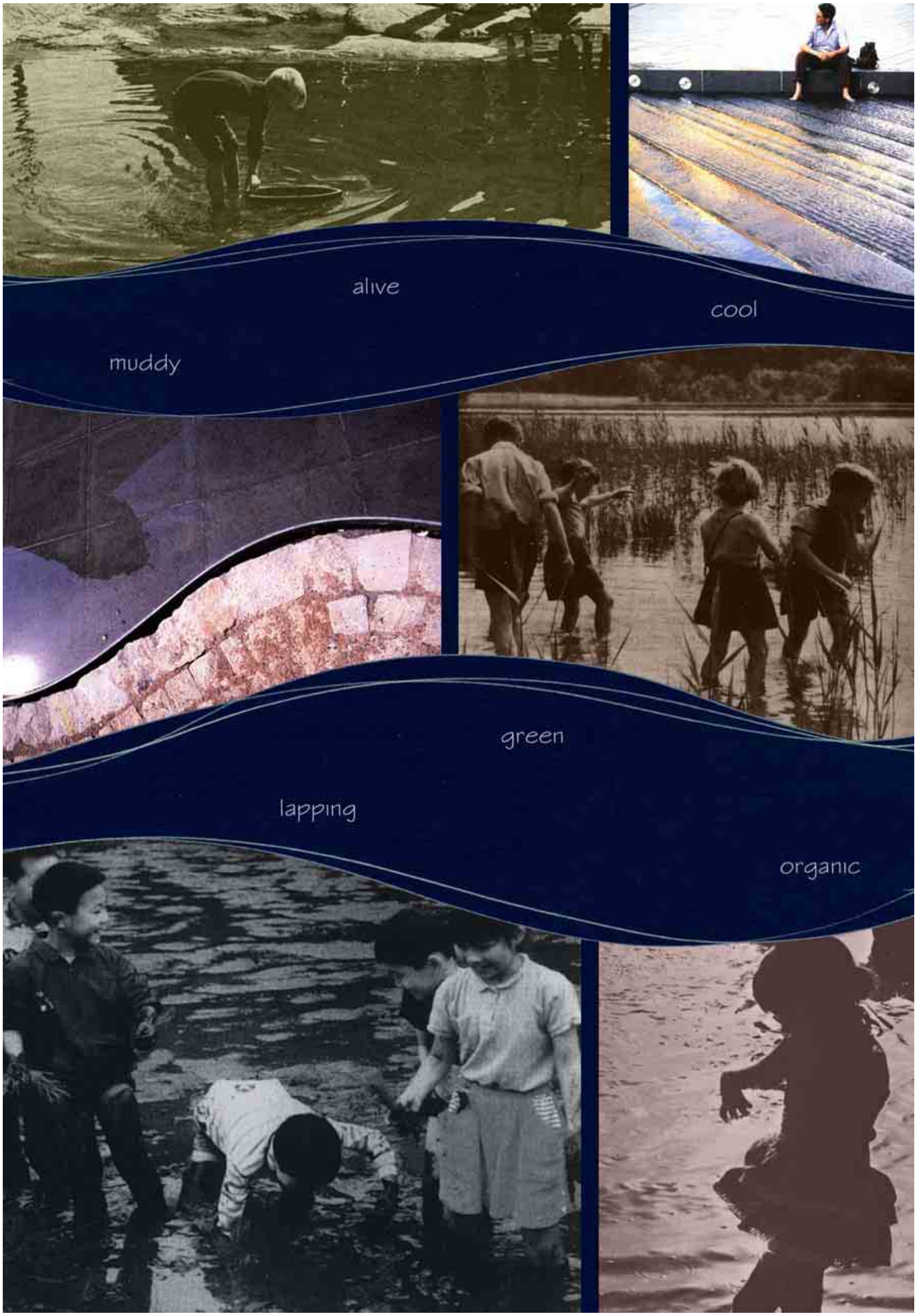

Figure 5.4 Pond edge (Bengtsson Child's Right 72, Crandell 102 &111, Alexander 358, Brett, Moore and Provenzo 110, Bengtsson Adventure 79)

Stepping stones – like boulder clusters, stone weirs	
Materials	large stable rocks or bridge
Depth/width/shape of bank and channel	moderately steep banks and narrow channel for bridge; fairly flat and wide channel for stepping stones
Speed/movement	moderate
Vegetation/organisms	various
Play activities	jumping, balancing, wading, risk taking

Waterfall – like weirs or other grade control measures	
Materials	medium to large rocks
Depth/width/shape of bank and channel	sharply dropping (not necessarily far, just abrupt) in channel
Speed/movement	rapid, turbulent
Vegetation/organisms	n/a
Play activities	sliding, floating objects, swimming

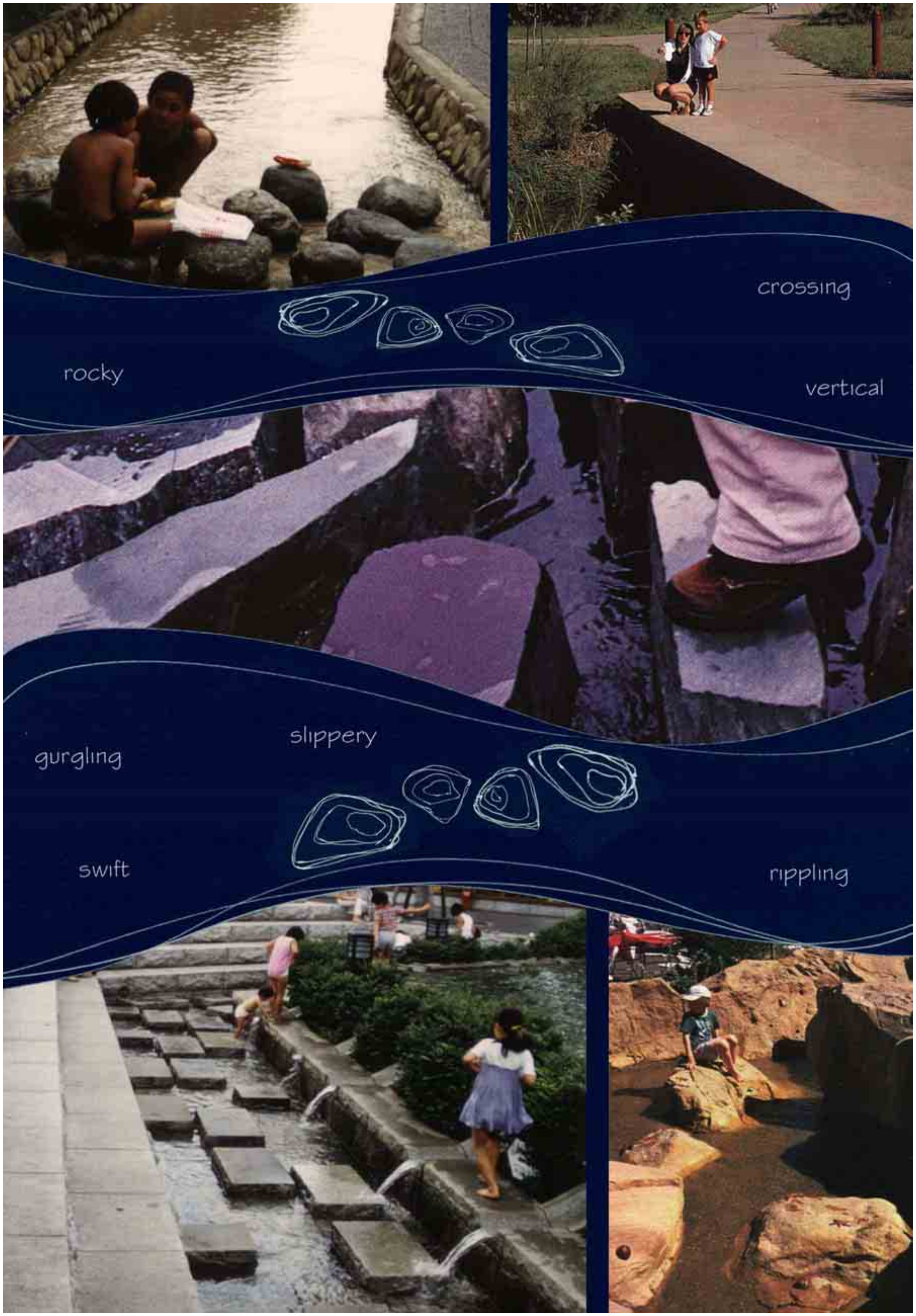

Figure 5.5 Stepping stones (Yokoyama 37 & 46, Strutin 51, Brown 68)

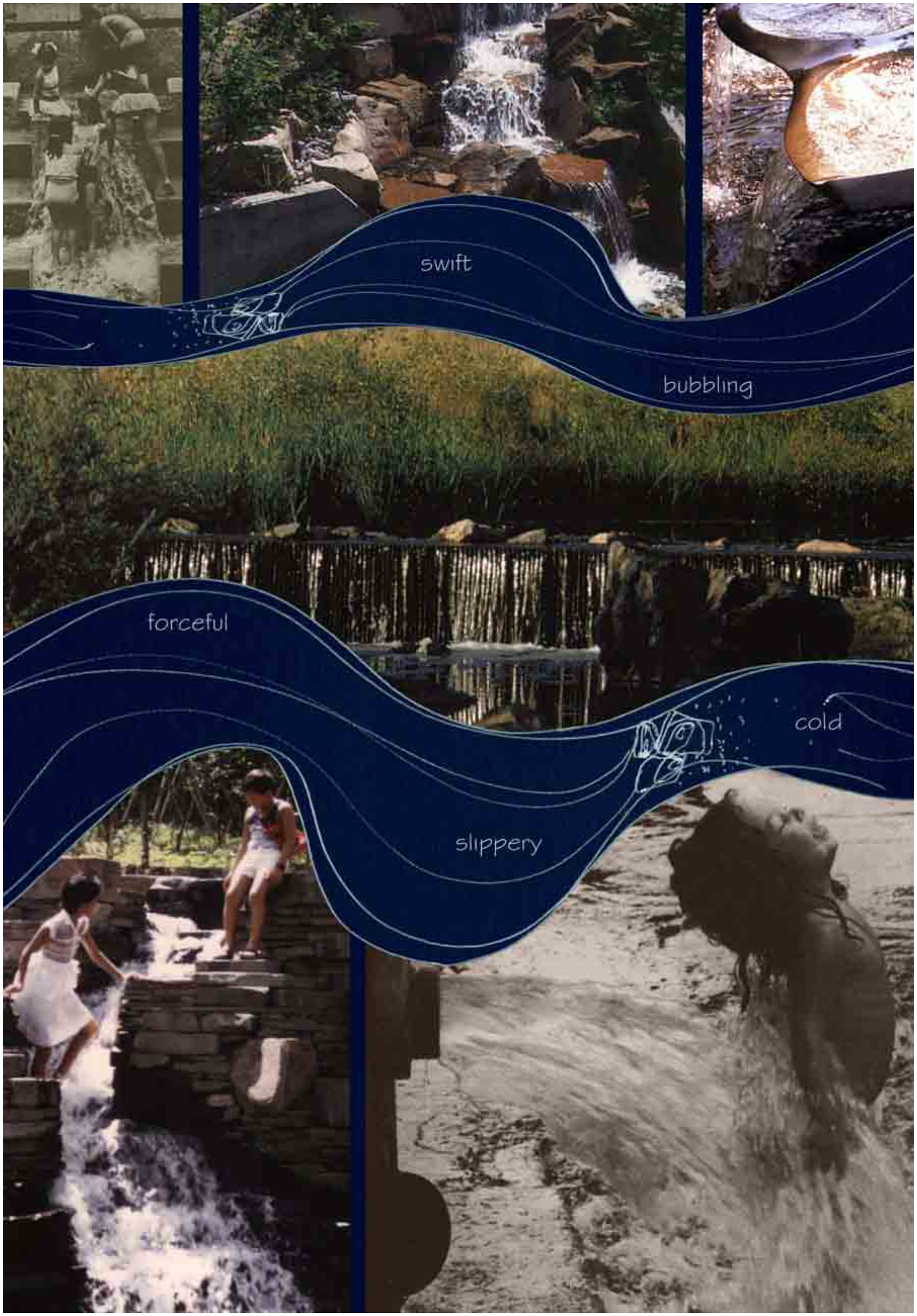

Figure 5.6 Waterfall (Friedberg 28, Calkins 24, Crandell 108, Strutin 51, Yokoyama 49)

<u>Design Application of Patterns to Tanyard Creek</u>

The site for design application is a small portion of Tanyard Creek in Athens, Georgia. This section of the creek, currently culverted, is located along Newton Street adjacent to a public housing project, playground, and day care center. The nearby playground and the residential nature of the site make it a likely place for play.

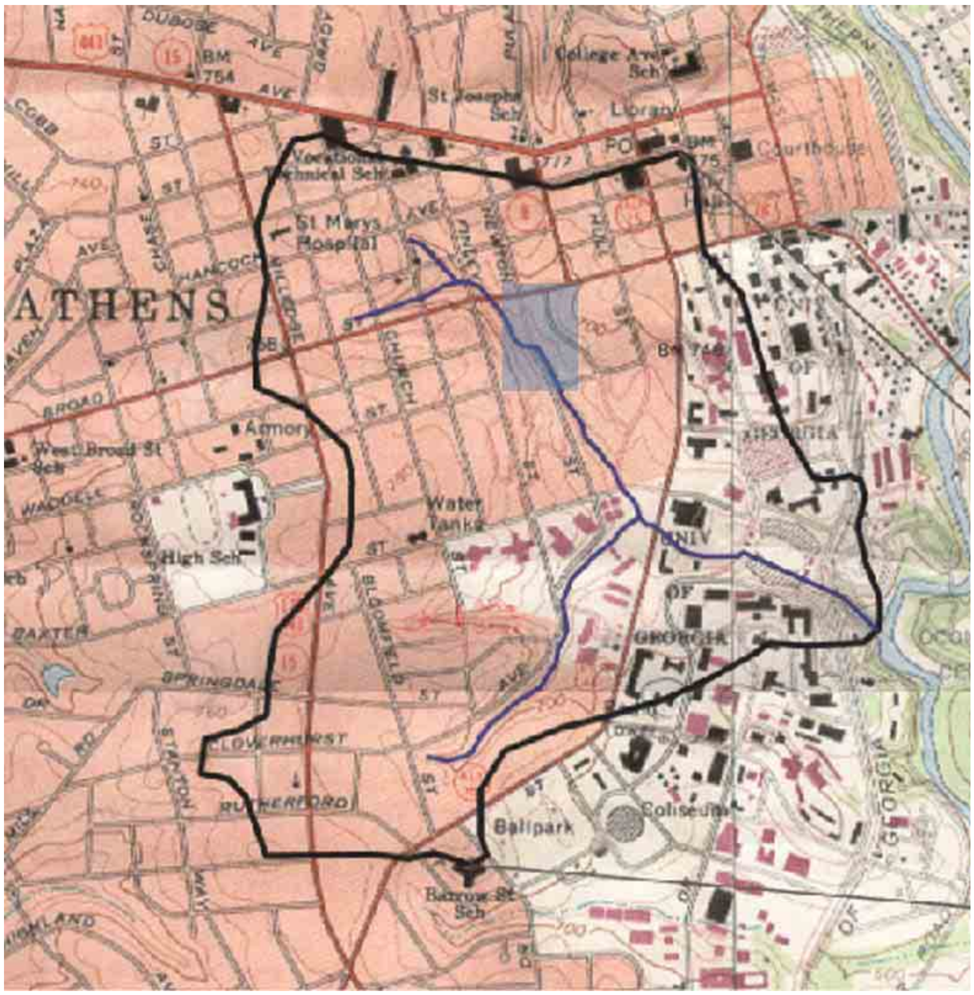

Figure 5.7 Tanyard Creek location and watershed, study site highlighted (Uhrich)

Tanyard Creek flows through an urban area of Athens and onto the campus of the University of Georgia (see figure 5.8). Many areas are culverted, and much of the rest of the creek is inaccessible due to choking vegetation, fencing, or extremely steep banks. It is a vehicle for stormwater traveling from streets and parking lots to the Oconee River.

Figure 5.8 Tanyard Creek on the University of Georgia campus (Aten)

Due to these sources of non-point source pollution and leaking sewer systems, there are a variety of dissolved solids and some e. coli present in Tanyard Creek (Uhrich). The creek does not, however suffer from significant point source pollution in or upstream of this study area. Downstream, the university contributes to high levels of potassium and nitrogen, possible due to the drainage of the football field in Sanford Stadium. These pollutants are neither uncommon nor particularly hazardous relative to other urban streams, but significantly compromise the health of Tanyard Creek.

Within the study area, the creek is currently located underground, beneath Newton Street, adjacent to Athens public housing. The residences are one and two story attached dwellings. Each unit opens on to a balcony or small patio, with direct access to lawns and sidewalks. The current path of Tanyard Creek is indicated by two old bridges and is visible through a grate in the lawn near Newton Street. The level of the creek varies from one storm drain to another, from approximately six to ten feet under the existing grade.

Figure 5.9 View of Newton Street with Tanyard Creek culverted underneath

Figure 5.10 Vegetable garden

Figure 5.11 Public playground

This design for the renovation of Tanyard Creek on this site would require closing a portion of Newton Street between the two bridge remnants. Access to the Holiday Inn Express and ABC Day Care would be allowed, but Newton Street would dead end just south of those two drives, and resume at the intersection with Waddell.

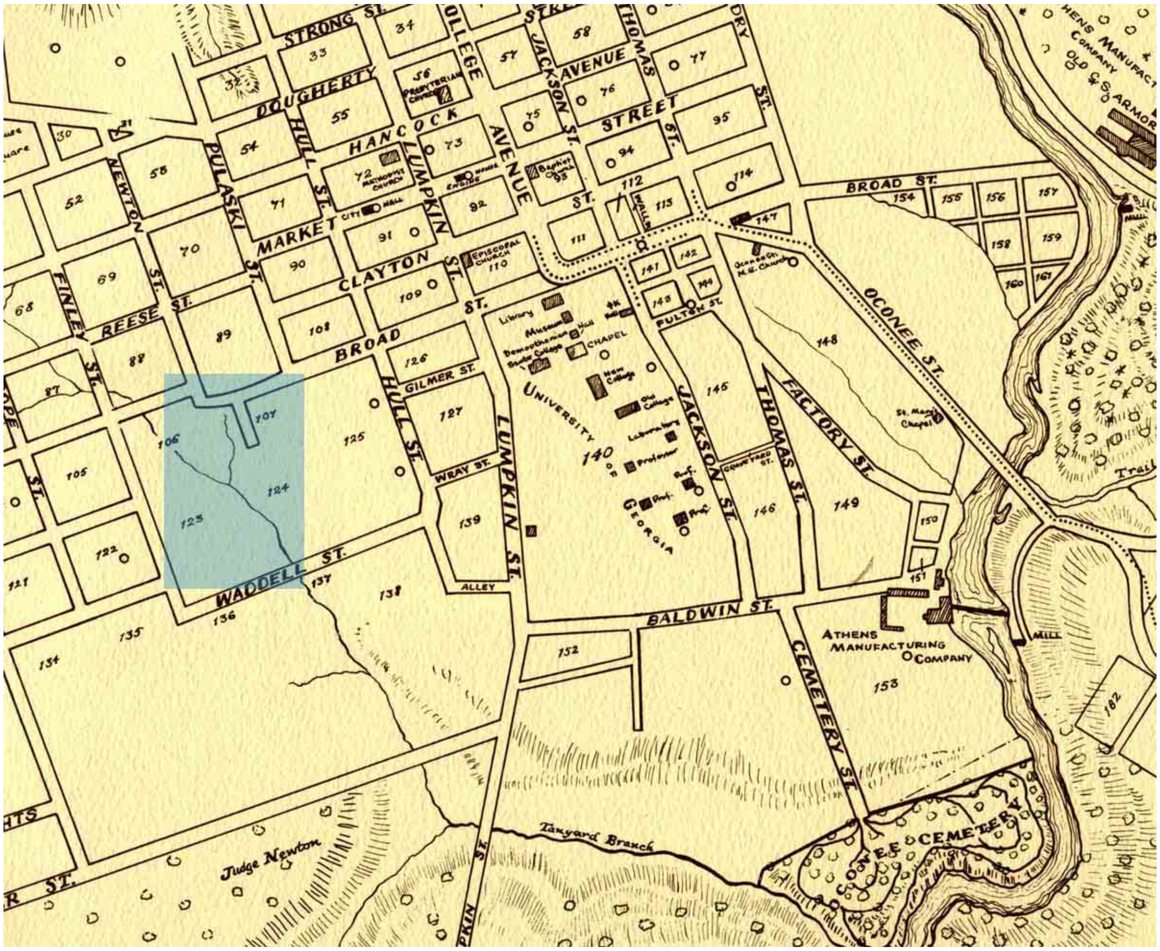

Figure 5.12 Tanyard Creek location, c.1874, study site highlighted (Aten)

The path of the stream itself is shown in the plan for the redesign of Tanyard Creek (figure 5.15). The meanders and location of each pattern are loosely based on Leopold's illustration (figure 5.13) and the historic site of the stream (figures 5.12 and 5.14). More currently unavailable information about the historic site and level of the stream as well as current flood information would be appropriate to include in future refinements of the stream renovation.

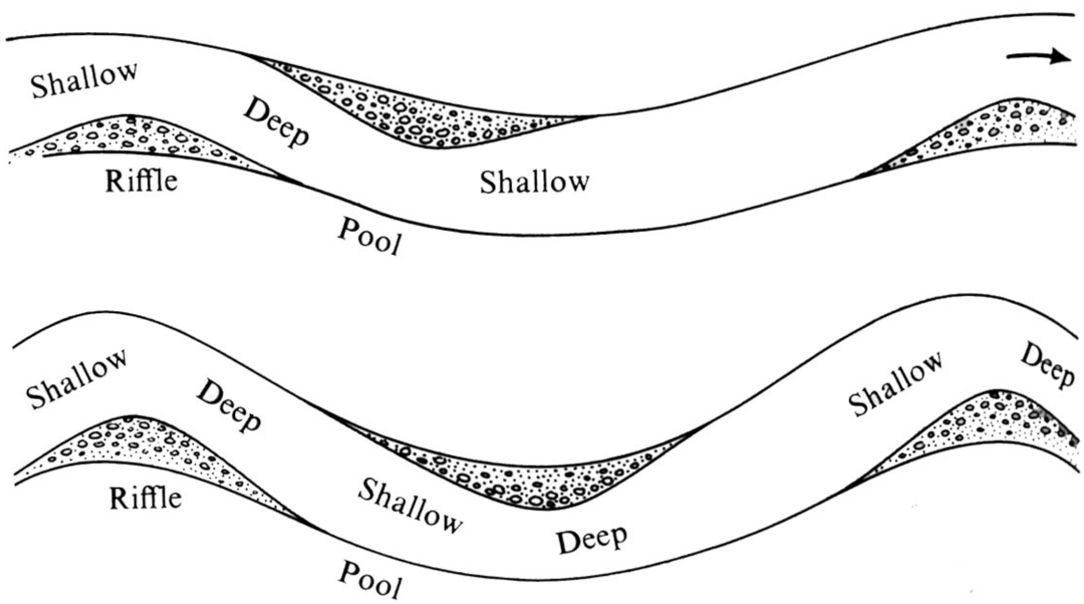

Figure 5.13 Stream meanders (Dunne and Leopold 626)

Management Issues for Tanyard Creek

One of the biggest issues for the daylighting of Tanyard Creek will be safety. Though actual risks are probably no greater than a traditional play area, there are legitimate safety issues including flooding, contaminated water, and steep slopes. The design does not fence or otherwise limit access to the stream. This practice is consistent with other stream daylighting projects on public property as well as other natural features (such as climbing trees) or man-made elements (such as heavily trafficked Broad Street). A (handicap accessible) walking path and bridge which connect to existing sidewalks and circulation routes are included in the design to encourage interaction with Tanyard Creek. Because of its unlimited access, interpretation, education, and safety information must be included in the project. This may take the form of public meetings, signage in numerous languages, and staff or volunteer supervision. City maintenance crews will need education on the proper maintenance of a stream. Neighbors and visitors should be prepared for the somewhat scruffy and unfinished appearance of a newly established and growing stream landscape.

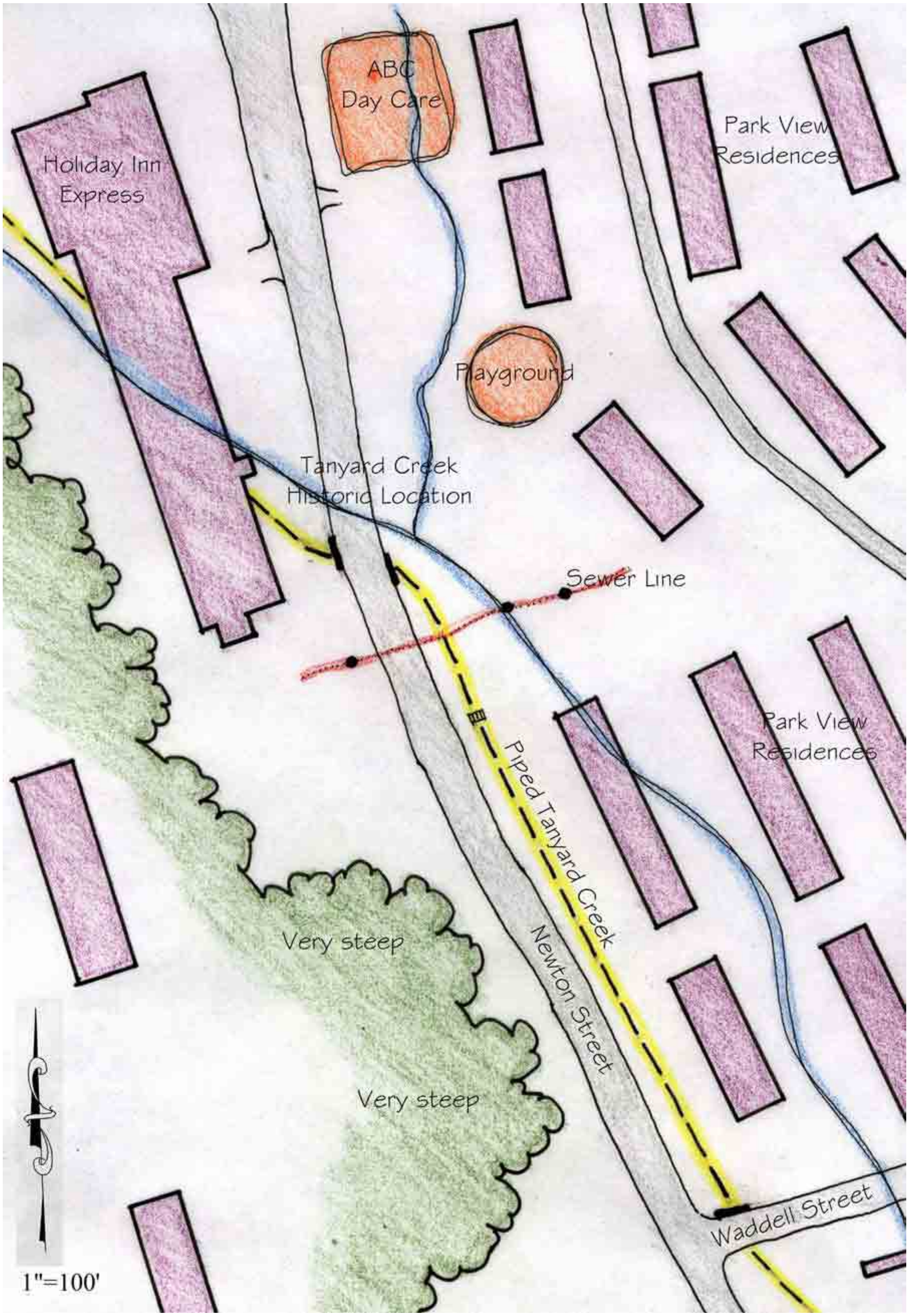

Figure 5.14 Tanyard Creek inventory

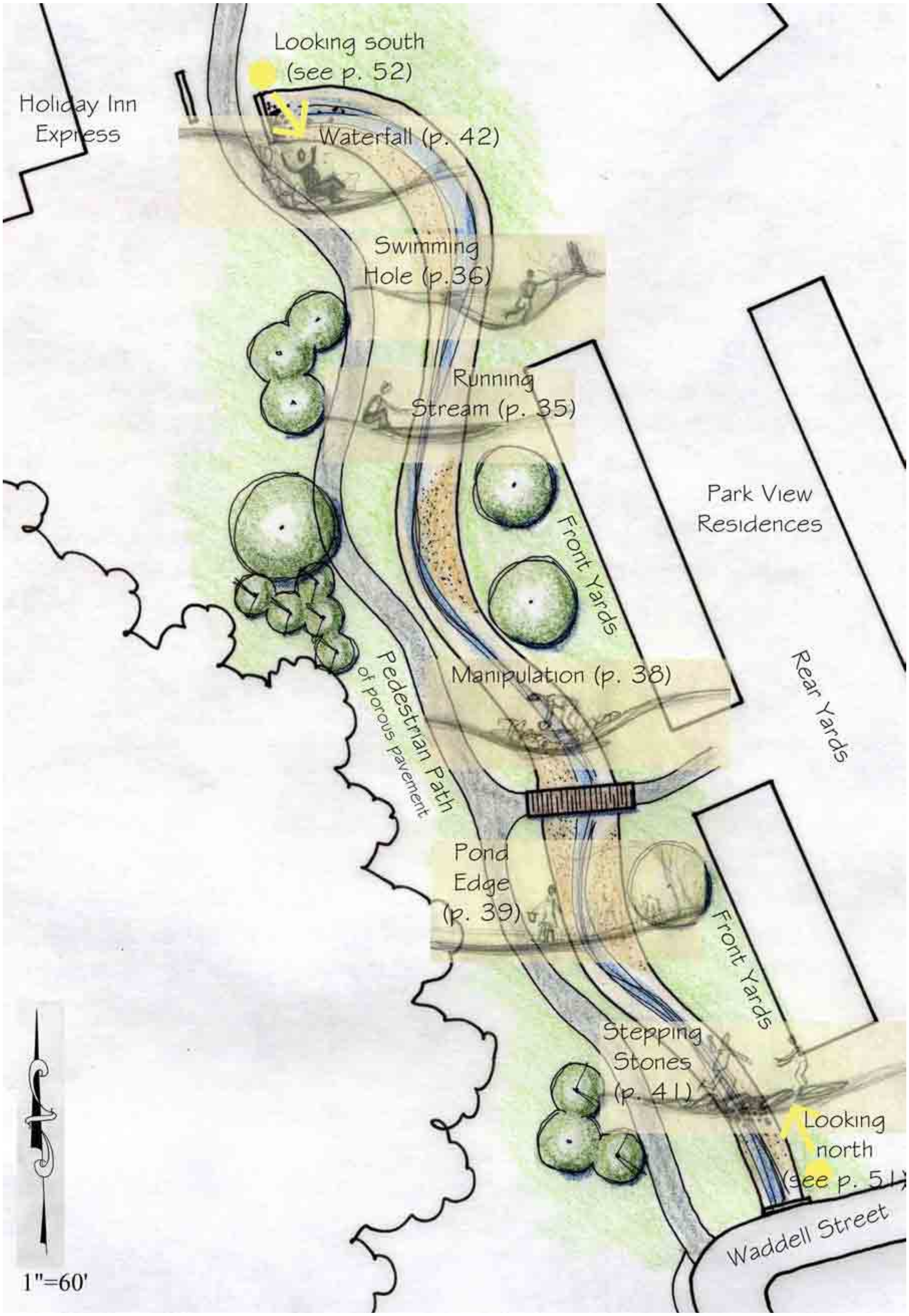

Figure 5.15 Tanyard Creek renovation plan with pedestrian path and improved stream

Figure 5.16 Site looking north, before design, piped creek location in blue

Figure 5.17 Site looking south, before design, piped creek location in blue

Figure 5.18 Site looking north, proposed design

Figure 5.18 Site looking south, proposed design

CHAPTER 6

EVALUATIONS AND CONCLUSIONS

Design Considerations

The design of Tanyard Creek as explored in this thesis is merely the first step toward the project becoming reality as a play space for the children of Athens. If the daylighting project were pursued, this study would serve as a starting point for further research and design. Many specifics need to be known in order to move the project forward.

The current typical volume of flow in this portion of Tanyard Creek will have a large impact on the proposed design. Will there be enough water at all times of the year to provide the play experiences intended? On the other hand, how does the design accommodate flood levels, and what are the 2-, 10-, and 100-year flood volumes?

Currently, Tanyard Creek flows several feet below the surface of Newton Street. At what level should the stream flow and what are the resulting bank angles? Do these angles accommodate the desired access, and what materials will be used to stabilize them? Within the streambed, what are the slope and dimensions of the stream and what are the appropriate materials for dynamic but stable construction?

Pollution control and mitigation will play a large role in design. Assuming the known problems such as leaky sewers are corrected upstream, how can other non-point source pollution be minimized? What is the treatment for stormwater from incoming laterals? Will this water with its sediment and pollutants be collected, diverted, or treated in any way? What positive impacts can this project have on the downstream condition of Tanyard Creek?

Many habitats for plants and animals are present both within and outside the streambed. What plant species will be included for habitat and for play? What should be the minimum with of this buffer?

Such a drastic change in the landscape will have a significant impact on adjacent residents and other neighbors. How can the safety of all people be guaranteed? How will the stream impact the private space of the residents' yards? Can the project go forward without the support of the neighborhood? To what city regulations and ordinances will the design need to adhere? How should the stream be linked to the existing playground and child care center?

This list of questions is intended to illustrate some of the issues involved with the daylighting of a stream and to provide guidance for any further work on Tanyard Creek. Perhaps the most important of the above considerations is the impact on the neighborhood. The support and enthusiasm of residents proved essential in the successful case studies discussed in Chapter four. The Tanyard Creek daylighting project could probably not succeed without the positive backing of the Park View neighborhood.

Children and Streams

I chose to write my thesis about the topics of children's play and urban streams. Children are invigorating, exciting, and fun. Water is an essential part of life; indeed, it is the key to life as we know it. The idea that children may discover this fact as they play and retain that knowledge and understanding throughout their lives is the inspiration and validation for this study. As the earth's population grows, it is essential to provide places to discover and expose natural processes. Children have the potential to absorb the meaning of such processes and their place in them. This knowledge must be instilled in all people so that humans can better understand and manage their place on the planet.

Finding the overlap of play environments and urban streams is easier than it might first appear. It was surprising and gratifying to discover many wonderful examples of places for children to play with and learn about water and the layers of life it supports.

Innovative design for children exists throughout the world, though it is still outnumbered by bland, sterile, and boring play spaces with no connection to nature or process. Fortunately, the rural and undeveloped areas of the earth offer innumerable opportunities for children to play in the natural environment. For this reason, I chose to concentrate on the status of children and streams in urban areas.

The investigation focuses on a specific and rarely studied aspect of design, and in this way is a unique and necessary work. This thesis may make the issues of the poor conditions of children's play areas and urban streams more noticeable simply by discussing them. In addition, the neglect of Tanyard Creek by the University of Georgia despite the attention of student groups is unacceptable. This study may add to the argument presented to the university by S.E.E.D.S. (Students and Educators for Environmental Design and Sustainability) to acknowledge and highlight Tanyard Creek in its Master Plan.

Though I constantly tried to focus on creativity and design while working on this thesis, I inevitably learned a lot about the sciences of play, children's development, and hydrology. It also served to push me in methods of graphics and communication, trying to communicate a changeable and flexible design in a book format. For these reasons, the work was worthwhile as a personal learning exercise for me even if it does not affect a larger audience.

I hope that this work reveals some of the problems with the way that our society deals with children and natural processes. On the whole, both tend to be neglected or buried out of sight. The overlap between urban children and urban streams is health. By improving urban stream health, we can provide a wonderful and invigorating place for play. As a result, children's social, physical, and psychological health can also improve. Acknowledging the layers of systems in urban places exposes the relationship between people and the environment. This study has focused specifically on the interaction between children and streams. It has revealed that the goals of children's health and stream health are related. Much more work is necessary to bring these issues to a more visible place in the world. Both children and streams should flourish and be a celebrated part of our society.

Figure 6.1 Wading (Nabhan and Trimble iv)

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