Generating a Contemporary Sustainable Landscape

by

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Abstract

This thesis explores landscapes and their capacity to affect change in an increasingly technological world. It questions the nature of technology and reflects on the cultural dichotomy existing between organic nature and technological structures in modernity. Specifically, it attempts to counter this physical and perceptual break through the development of new relationships between landscapes and attempts at sustainability. I position sustainable landscapes as a way to critically intervene and restructure our association with technology and the organic landscape, and question whether sustainable power generation, which is a facet of our modern technological identity but yet is dependent on the interaction with organic nature, can act to invigorate that landscape. The architectural/landscape design component of this thesis thus proposes the generation of a contemporary sustainable landscape within LeBreton Flats in Ottawa, Ontario that is defined by a publicly accessible small-scale hydroelectric facility and an associated public park.

Table of Contents

List of Tables

List of Figures

Part I

Introduction

Chapter 1: Introduction

Organic elements and technological structures in the contemporary landscape mirror the way we see and interact with the world. They are the physical context in which human life is experienced and they expose a dynamic set of relationships centered on notions of place, memory and identity. While the role of "landscapes" is not consistent throughout cultures, the understanding of a landscape always reflects the way a culture perceives and affects nature or the organic through technology. With the ever-increasing predominance of technology in North America however, the organic has been increasingly subsumed by the formation and use of technological systems. From acid rain and pollution to satellite imaging, every part of the organic landscape has been in some way measured or affected by modern technological acts. Even our perception of such ecosystems has changed, with the organic landscape becoming an environment to view rather than a place that can mediate our modern technological dependence. Similarly, technological structures have been accepted unconsciously and uncritically, forming a blind framework from which we order our modern lives. The resulting cultural dichotomy between organic nature and technological structures not only continues the degradation of the environment but also does so without a public awareness of how and why this violence against the organic landscape occurs.

As inhabitants of a large, diverse and relatively unpopulated northern country, Canadians are quick to identify with the organic landscape. With a wealth of natural resources and a variety of ecosystems, we can witness and experience these distinctive places with relative ease – from the temperate rain forests of British Columbia to boreal forests of the Canadian Shield. Unfortunately, as we settle in large cities and shift from what was largely a rural population base only a century ago to an urban society, our ability to interact with these places has slowly been compromised. While there is a growing awareness of the effects of our technologies upon the organic world we still have a long way to go. Legislation such as the Kyoto Accord, which calls for a global reduction in fossil fuel emissions, was recently ratified by the Canadian government, and if enforced, will see environmentally progressive measures and penalties applied to our worst industrial polluters. At the individual level, programs such as the One Tonne Challenge, call for average Canadians to curb their energy use, reduce carbon dioxide emissions and support a lifestyle of conservation. Yet, if we hope to bring Canada towards a responsible future we must not only support these trends but also truly attempt to understand the tenuous relationship shared between the organic landscape and technological structures in modernity.

Architectural/Landscape Proposition

The architectural component of this thesis explores the creation of a sustainable landscape on LeBreton Flats in Ottawa that is supported by a small-scale hydroelectric generating station and an associated park. The hydroelectric facility is a sustainable technology and thus, offers a reflection on the ability of technological structures to work with the organic landscape. Since the generating station is situated within an urban environment and a park, the architecture has been developed to permit a systematic revealing of the formation of said technologies, their function, and their relationship to the organic landscape to the general public at large.

While preoccupations with security are a contemporary concern with all infrastructure systems following September 11th, 2001, it must be noted that this thesis focuses on the more positive aspects of sustainable power generation and the social and environmental benefits it has the potential to provide. As September 11th illustrated, no building can be entirely protected. While systems can be put in place to offer some security protection I have no desire to see our cities, institutions and infrastructure systems walled in behind layers of concrete and steel. These measures not only, ironically, instill a level of fear in the general public, they compromise the way we move through space. Dealing with the development of a sustainable landscape I have turned to an *inclusive* strategy that attempts to connect the landscape and its technological structures to as many people as possible. In this capacity, traditionally removed technological systems can be understood, appreciated and ultimately protected exactly because they are vital institutions in our modern lives.

Part II

Theory

Chapter 2: Technology

The organic landscape, which is composed of all the living and elemental forms indigenous to Earth, is a system in constant flux. As an immense ecological cycle it is delicately balanced and transformed through the interactions between organisms and natural elements. These processes were once primordial - existing outside the creative and constructive capacity of humankind. Through the millennia however, our place within the organic landscape was slowly compromised through the use of technology, which is defined as the broad range of utilitarian objects created by humankind to satisfy perceived social needs. The organic landscape became an object of scientific inquiry and a resource to maintain economic progress, as we controlled and exploited the planet's natural elements and diverse forms of life.

Technological Identity

Lewis Mumford, the social and cultural theorist who wrote extensively on the formation and use of technology, addresses this transformation in his 1934 book, *Technics and Civilization.* While the text precedes the continued refinement and use of new technological devices throughout the twentieth century and beginning of the twenty-first century, it nonetheless characterizes the adoption of technology in society and its increasing ambivalence towards the organic. Principally, it positions technology as a socially adapted mechanism that has evolved through three periods, the eotechnic, paleotechnic and neotechnic, and that can ultimately be seen as an extension of our own technological body.

While it can be argued that the use of primitive tools provided a definitive break with the natural ebb and flow of the organic and allowed humankind to hunt other animals that would have otherwise been predators, I will support Mumford in postulating that it was instead, the evolution of the human body and mind that accounted for the initial displacement from the organic. Before we even considered or attempted to control or exploit the organic landscape, we first had to control or own thoughts, gestures, and movements. Mumford captures this sentiment in the following quote, taken from an essay he wrote in 1975 entitled, *Two Views on Technology and Man*, when he states:

> All man's technological inventions are embedded in the human organism, from automation to cybernation: automatic systems, so far from being a modern discovery, are perhaps the oldest of nature's devices, for the automatic responses of the hormones, the endocrines, and the reflexes antedated by millions of years that supercomputer we call the forebrain, or neopallium … It was this studious technical development of the organism as a whole, not just the employment of man's hands as facile tools or tool-shapers, that accounts for the extraordinary advances of Homo sapiens. [1]

Prior to the development of tools, humankind had no way to purposefully modify the environment. As a result, operating under the direction of the "highly activated brain" [2] early Homo sapiens slowly transformed the way in which they interacted with the world around them. They began walking upright, desired repetitive tasks, and communicated via sounds and hand gestures. In this capacity the human body and mind evolved, and operating in the same capacity as a technological system, enabled humans to procure foodstuffs, find shelter and ultimately interact with other individuals living in the same

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[1] Lewis Mumford, "Two Views on Technology and Man," Technology, Power, and Social Change, ed. Charles A. Thrall, (Toronto: Lexington Books, 1972) 3.

[2] Mumford, Technology, Power and Social Change 3.

area. In particular, this social interaction supported the development of small communities connected by a rudimentary language.

Technological Objects

The notion of previously isolated individuals coming together to form loosely based communities had a large impact on the development of technological devices and the continued evolution of the human mind. While these communities offered a sense of security against an unforgiving landscape, they also enabled the continued refinement of language and the passing of knowledge between members of the community. Furthermore, with a larger population base centered in one area, labour projects that would have been inconceivable only centuries before could be completed rapidly and with a certain technical precision. Since it was sometimes difficult to coordinate a large group of individuals, technological devices were thus constructed of wood to help with the work. [3] While these devices were crude, they nonetheless became an important part in the life of a community, contributing to the cultivation and hunting of food, and ultimately the creation of fire. Round logs laid side by side during the Paleolithic era (15,000 to 750,000 years ago) would have been one such device. As a precursor to the first wheel, which was invented in ancient Mesopotamia around 3500 BC, the use of the logs would have permitted large loads to be transported over long distances with greater ease and substantially fewer men. The resulting adoption of these early technological devices allowed humans to modify and control the organic landscape regardless of individual physical strength and thus, accelerated their use and prominence at the early stages of human development.

[3] Mumford, Technology, Power and Social Change 8.

Technological Displacement

The displacement of the human body from the organic landscape and its ensuing reliance on technological devices became particularly evident with the formation of the monastery during the Middle Ages, where under the strict discipline of the Church the natural "irregularities" of the organic landscape were mitigated by its protective enclosure. At that time the organic landscape was associated with disorder and thus, to prevailing Christian ideology, it became a place that must be mediated and tamed. As a result, humans resided as stewards of the land and intentionally ordered the organic landscape or "wilderness" to appear civilized. In this capacity, God's destiny was manifested as they brought forth "the fruits of the earth." [4] With rules governing the way in which the inhabitants moved through the monastery and surrounding landscape, their lives were also regimented by the Church rather than by the cyclical nature of the landscape. This became particularly evident with the striking of Church bells at measured intervals throughout the day. This technological act marked significant events and with the later development of the mechanical clock, "Eternity" or the natural ebb and flow of the organic, "ceased gradually to serve as the measure and focus of human actions." [5] With measured time, human lives were completely inscribed within the scope of technological systems, and with the rise of scientific rigor and fact during the Renaissance, the organic landscape was marked as an exploitable resource privy to human's dominating tendencies.

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[4] Max Oelschlaeger, The Idea of Wilderness: From Prehistory to the Age of Ecology, (Hew Haven: Yale University Press, 1991) 70.

[5] Lewis Mumford, Technics and Civilization, (NewYork: Harcourt, Brace & World, Inc., 1962) 14.

The "Essence" of Technology

There is no denying the profound effect technology imparts on Western civilization. From automobiles, computers and phones, to agricultural practices and food cultivation, modern technological devices have become extensions of our bodies. We rely on them to support both basic human 'needs' and an ever-increasing list of 'wants.' In many situations the technological devices have even replaced our own actions; the assembly line and medical devices such as the pacemaker are only a few examples. While I have just briefly described the evolution of our modern technological capacity, it is still necessary to question how an object becomes technological. It is in this regard that I will turn to the work of Martin Heidegger, the early nineteenth century German philosopher, who wrote extensively on the "essence" of technology. In his pivotal 1954 essay, *The Question Concerning Technology*, Heidegger states that the modern technological world has failed to understand the truth behind technology.

Technology, Heidegger writes, is derived from the Greek word *technikon* or that belonging to *techne* and *logos*: *techne* being the wisdom gained from uncovering the truth of things and *logos* the essence of language. The productive nature of uncovering this truth is *poiesis* or a bringing-forth. The truth gained from discussion (*logos*), disclosing (*techne*) and action (*poesis*) is the essence of technology. Technology is manifested as a mode of revealing or a "setting-upon" of the intrinsic worth of natural objects and our ability to understand this transformation. As such, technology can be shown to be both anthropological as a natural human activity structured on our technological identity, and instrumental as an activity structured on a means to an end. [6] Technology can thus be seen to represent those objects that have been removed or placed outside of the organic landscape because of qualities deemed useful or beneficial for human use.

To offer an example, we might revisit the round logs laid side by side. For one group the round logs are simple extensions of the organic, subject to cycles of growth and decay as they interact with organisms and the natural elements. For the other group who purposefully selects such specimens and lays them beside one another, the logs are seen for their technological capacity and ability to improve the transfer of large objects. In this form the logs are not seen as an extension of the organic landscape but rather as an object with intrinsic worth. To quote Heidegger:

> Man, within the subjectness belonging to whatever is, rises up into the subjectivity of his essence. Man enters into insurrection. The world changes into object. In this revolutionary objectifying of everything that is, the earth, that which first of all must be put at the disposal of representing and setting forth, moves into the midst of human positing and analyzing. The earth itself can show itself only as the object of assault, an assault that, in human willing, establishes itself as unconditional objectification. Nature appears everywhere – because willed from out of the essence of Being – as the object of technology. [7]

Reflections on Technology

Every technological object has in some way been willed from the organic landscape. Whether in their material form or through the energy used in their operation, we purposefully select certain objects through our technological foresight and transform them to perform certain tasks. The round logs are but one example of our objectification of natural elements; if we trace the formation of plastics we can observe that they were

[6] Martin Heidegger, "The Question Concerning Technology," The Question Concerning Technology and Other Essays, trans. William Lovitt, (New York: Harper Colophon Books, 1977) 12.

[7] Heidegger 100.

once decomposed plant and animal matter, which over the millennia have been transformed into oil and natural gas through heat and pressure. However, what becomes particularly troublesome is that these modes of revealing, or understanding why and how technological objects are willed from the organic landscape, have been lost to modern society. Instead of a systematic *revealing* with technology, there has been widespread *concealing*. Robert Thayer, a theorist and professor of landscape architecture, captures this sentiment when he states:

> Scarcely a day goes by in the life of most Americans without at least some form of interaction with nature, land, and technology … On a day-to-day basis, however, we don't comprehend the relationship between nature, technology, and landscape in a deliberate or conscious manner, and what interactions we do experience are merely manifestations of our typical lifestyles, tastes, and desires. [8]

For the most part we have no idea where technological objects originate, how they come into being, and what are the associated environmental impacts of their use. As a result, the organic landscape continues to be degraded as we accept technology unconsciously and uncritically in our everyday lives.

To put this technological *concealing* into perspective the following chapter examines the power generating process, and the extent to which we remain dependent on the technologies that generate electricity. This is illustrated through the electrical blackout of August 14th, 2003, where I show how the unprecedented loss of electricity (caused by an over-use of technological devices) was only momentarily assessed by the general public. The subsequent return to peak electrical use following the dramatic event underscores the social acceptance of technological devices as a mainstay of our lives, and a system that for all intents and purposes, we are unwilling to break. The case study thus

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[8] Robert L.Thayer, Gray World, Green Heart; Technology, Nature, and the Sutainable Landscape, (Toronto John Wiley & Sons, Inc., 1994) xiii.

positions why, I would argue, the design of the sustainable landscape (specifically the hydroelectric facility) should include a public dimension. In this capacity, the public visitor is able to experience the generation of electricity firsthand, and observe its technological components, the process by which electricity is generated, and ultimately, understand what are the environmental implications of such technological control.

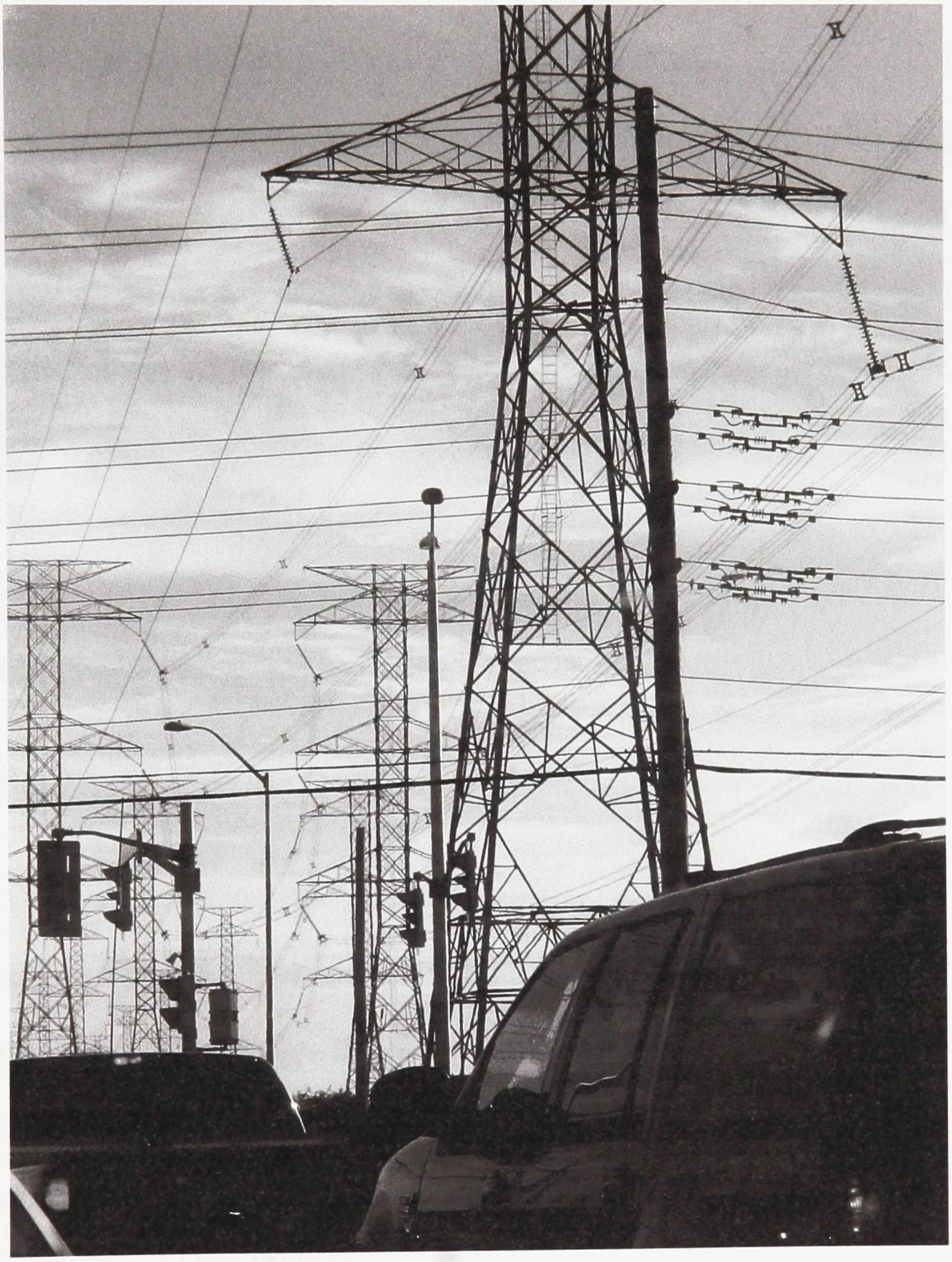

Fig. 1. *Technological Displacement*, Ottawa, Ontario, 2005. Photograph by author.

Chapter 3: Power Generation Case Study

The generation of electrical power consists of highly diverse operations, all controversial. While there is a variety of ways to produce electricity such as the burning of coal, oil and natural gas, the splitting of uranium atoms in nuclear fission, and the damming of watercourses in hydroelectric operations, the generating process is ultimately the result of transforming or harnessing natural elements existing within the organic landscape. Unfortunately, while providing the electricity to run many of our modern technological apparatuses, the exploitative act of power generation has not only degraded the organic landscape but has become an unknown and uncritically accepted platform from which to structure our daily activity. This resulting reliance on technological infrastructures powered through electricity has not only created artificial environments of temperature control and twenty-four hour lighting but has furthered a general disengagement with the organic landscape.

The 2003 Blackout

On August 14th, 2003 over fifty million Canadians and Americans living in Ontario and the northeastern states were plunged into darkness following an electrical blackout originating around Akron, Ohio. The extent of affected regions was not only the largest on record but the surge of electricity knocked one hundred power plants offline and left cities such as Toronto, Ottawa and New York City in the dark. In some locations power was restored within a couple of hours but for the majority of affected residents – both urban and rural - the loss of electricity lasted anywhere from a day to a week. In the ensuing darkness refrigerated food went bad, schools and offices were closed, streetlights remained black, and televisions, computers and air conditioners were inoperable.

As a northern country that is continually subjected to harsh weather anomalies, the August 14th blackout was not the first time that a part of Canada had been left in the dark. Ice storms, winter blizzards and thunder and lightning have repeatedly disrupted the electrical grid and knocked out power. What was unprecedented with the blackout was that it affected such a large and populous region and was triggered by our unprecedented electrical use. Caused by three high-voltage transmission lines in Ohio that sagged into tree branches and shorted out, the power quickly routed itself through other circuits where it created a destabilized current. Since the power grid is not autonomous to states or provinces but is rather an interconnected system of wires and transformers, the surge of electricity suddenly made the entire network unstable. Circuit breakers tripped to prevent equipment damage and the flow of power was stopped. Within a time frame of seven minutes, the northeastern states and the province of Ontario had no power. [9]

Effects of Electrical Loss

As a highly technological society we have come to depend on the flow of power to drive industry, light homes, and to use the technological apparatuses of the twenty-first century. This dependence has not only helped to establish a modern society but has in fact come to define our everyday actions and movements through space. While power (or electricity) is largely an invisible technology that is transmitted through wires, it nonetheless permits the use, and drives the creation of almost every conceivable

[9] Tom Spears, "Power Grid Still Fragile, Despite Lessons," Ottawa Citizen 14 August 2004: A4.

technological device in our modern age. With the blackout, North Americans were jolted from their technological reality and left to face their surroundings without the aid or conveniences offered by technological devices. Without electricity, North Americans had to redefine their lives for a brief period of time. Interestingly, during that period automobile use declined, and without the distractive nature of televisions or computers men and women stepped outside of their traditional technological domains to interact with the world outside. Furthermore, for a small percentage of the population, the experience enabled a reflection on the importance of power and technology in our modern society.

Unfortunately, a year after the historic event, North American society was once again using electricity at levels similar to the peak demand of the previous year. Energy efficiency had become passé as the uncompromising force of modernity and technological development had necessitated a continued use of power and the degradation of natural resources in the process. As Morag Carter, the director of the climate-change program at the David Suzuki Foundation in Vancouver would remark a year after the blackout, "People did think quite seriously about what they were using and how they were using it immediately after the blackout. But later, the issue dropped off most people's radar." [10]

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[10] Jonathan Fowlie, "Hungry for Power," The Globe and Mail 7 August 2004: M2.

Chapter 4: Technological Structures

For the majority of North Americans, technology has not only tethered their lives to intensive energy consumption, but has created a system that for all intents and purposes, cannot be broken. As Gordon Laird, author of *Power: Journeys Across an Energy Nation*, a foray into Canada's diverse power generating processes and their ecological consequences articulates:

> Power was the ideology of modern Canada – of luxury, progress, knowledge and health – that transformed a semi-frozen nation of people who, quite literally, lived in the dark. It was a test of our ability to control and improve upon natural environments, to extract prosperity from the landscape.[11]

We are tied to the technologies we have created and unfortunately, for the most part, they are objects premised on the continued destruction of the organic landscape. Power or electricity is one of these technologies, but what are the others? While I would gladly begin to list all the destructive technologies operating in our world today so that we might become better informed and thus, remediate environmental damage that has been done, there are just too many to consider. What I will do instead is briefly discuss the different types of technological structures that we use, witness and unknowingly accept. To support these characterizations I will turn to Robert Thayer's *Green World, Green Heart: Technology, Nature, and The Sustainable Landscape*, a book from 1994 that questions the varying ways in which we perceive, interact and understand the multitude of technologies existing or operating in the world today.

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[11] Gordon Laird, Power: Journeys Across an Energy Nation, (Toronto: Penguin Books Canada Ltd., 2002) 306.

Explicit Technology

Explicit technologies encompass all the objects that serve our modern utilitarian needs from the computer to telephone. They are as Robert Thayer states, "The contextual fabric of our modern experience – the human-altered backdrop against which most of our daily life occurs." [12] Unfortunately, as a highly conspicuous type of technology that supports the majority of our modern needs, we unknowingly accept them without questioning their potential environmental and social costs.

Fig. 2. *Telephones #21*, Hamilton, Ontario, 1997. Photograph by Edward Burtynsky.

[12] Thayer 114.

Implicit Technology

Implicit technologies are not necessarily objects but rather the forms and patterns left on nature after a technology has been used. [13] Ranging from the furrows of a ploughed field to the blasted rock abutting major highways, all of these modifications serve as stark reminders to our technological control over nature. While there may remain little of the technological source, the implicit technology is a visible and often dramatic juxtaposition of form and pattern against the organic landscape.

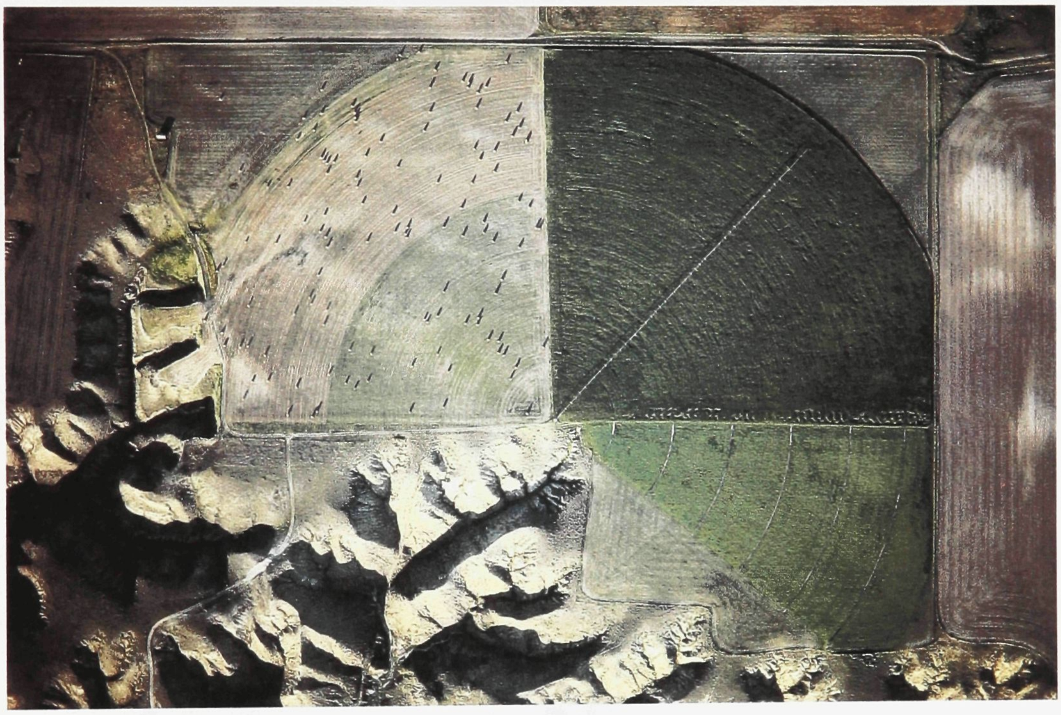

Fig. 3. *Segmented Field*, Teton River, Montana, 1996. Photograph by Alex S. MacLean.

Invisible Technology

Invisible technologies can neither been seen nor have any visible impact on the organic landscape. Our association with such technologies is instead mediated through

[13] Thayer 113.

more conspicuous technologies, which serve to contain or transmit them. [14] One type of invisible technology is electricity. Since it cannot be seen we are instead informed of its existence through the wires and transformers that transmit it and demarcate our urban and rural landscapes.

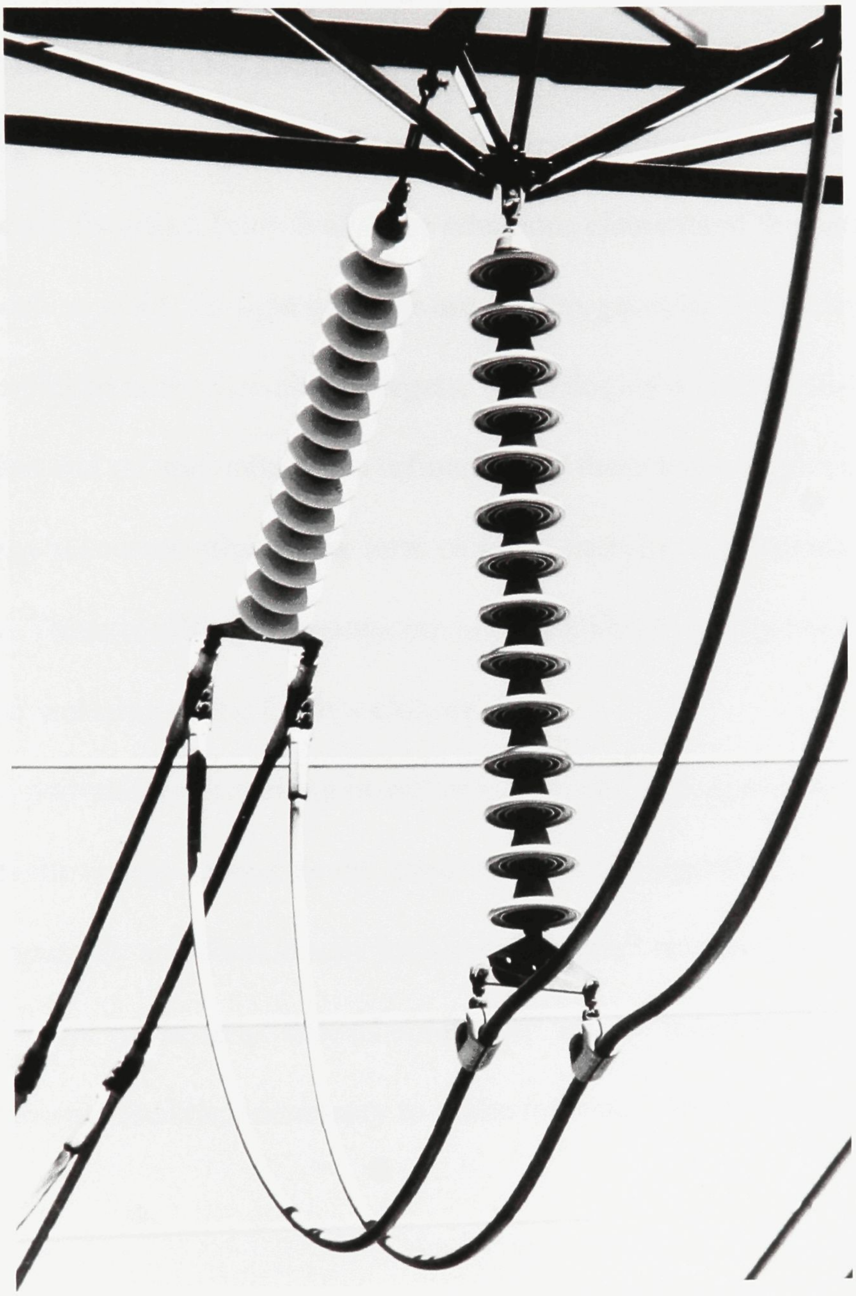

Fig. 4. *Transmission Lines*, Ottawa, Ontario, 2005. Photograph by author.

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[14] Thayer 113.

Energetic Technology

Energetic technologies take energy resources from the organic landscape and transform them to provide useful work. They may operate either renewably or non-renewably, meaning that in the use of energy the energy source is either replenished (renewable) or further degraded and compromised (non-renewable). Examples of renewable energetic technologies include wind turbines, photovoltaic cells and small-scale hydroelectric facilities. In each of these situations elements of the natural environment such as wind, sunlight or water are used to generate electricity with no by-products. Examples of non-renewable energetic technologies include coal-fired generating plants and oil and natural gas refineries. As these technologies are used they transform energy resources often in the form of fossil fuels into greenhouse gases such as carbon dioxide. These resulting emissions not only disturb air quality but have also been tied to a general warming of the Earth's climate.

What is particularly disturbing however is that while energetic technologies provide us with the energy to operate the majority of technological devices, they are for the most part "spatially and functionally incomprehensible" and absent from our view. They exist as Thayer states, in a "state of confusion" where "individuals lack the visual, spatial, and economic feedback necessary to make informed decisions about energy supply." [15]

[15] Thayer 118.

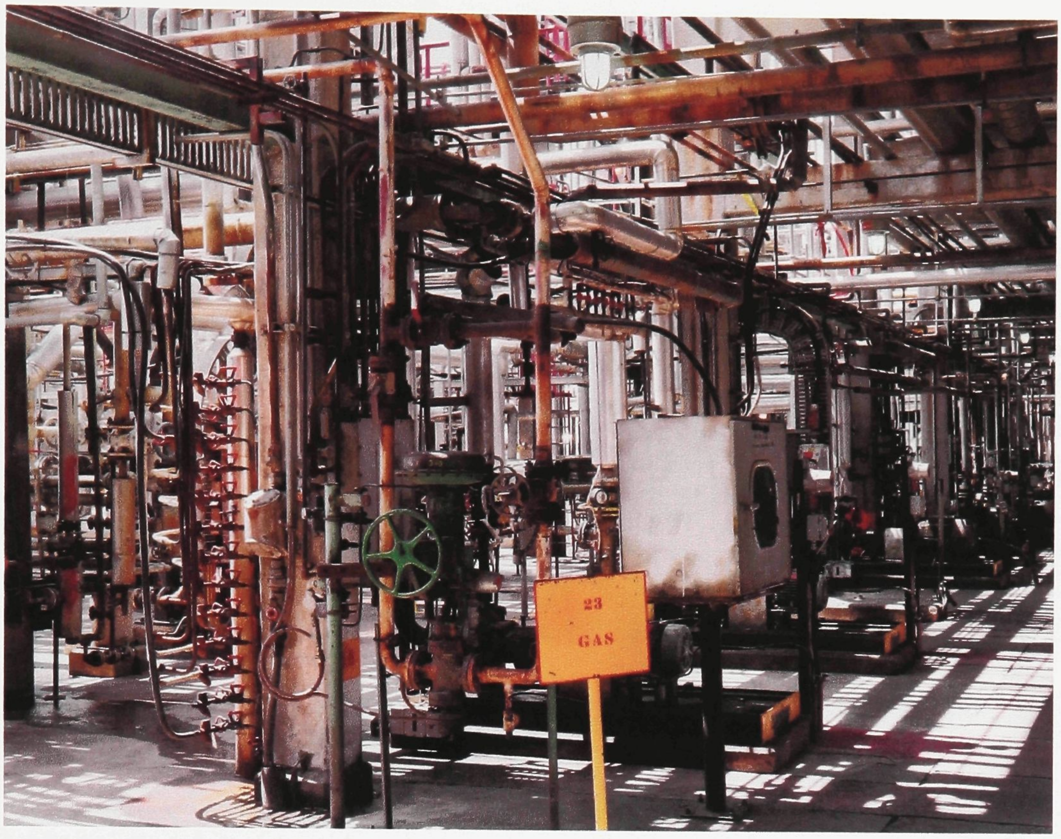

Fig. 5. *Oil Refineries #25*, Oakville, Ontario, 2001. Photograph by Edward Burtynsky.

Nostalgic Technology

Nostalgic technologies are those objects deemed out of date because of the continuing advances in technological structures. While they may still be operable their use has been curtailed by newer technologies that perform the same task faster, cheaper or with greater precision. One example is the automobile, which following a relatively short peak operating period of ten to fifteen years, is often substituted for a newer model and discarded to the scrap yard where it is left to weather. As such, nostalgic technologies remain as testaments to our technological past and serve as cultural markers documenting the continued evolution of technology.

Fig. 6. *Joe's Auto Graveyard*, New Bethlehem, Pennsylvania, 1935. Photograph by Walker Evans.

Sustainable Technology

Sustainable technologies provide tangible benefits to society without reducing the carrying capacity of the environment. They tend to utilize renewable resources and ideally, do not harm human health or the environment in their operation. While sustainable technologies are created in a similar fashion to the majority of other modern technological structures, and thus can be potentially damaging to the environment at their onset, it is important to note that it is their use that makes them sustainable. Once such technologies are put into operation, the negative consequences of their construction are tempered by the ability to limit future damage to the organic landscape, or in some instances remediate past mistakes. As a result, sustainable technologies can vary from the renewable energetic technologies of wind turbines, photovoltaic cells and small-scale hydroelectric facilities to smaller objects such as compost bins and recycling boxes.

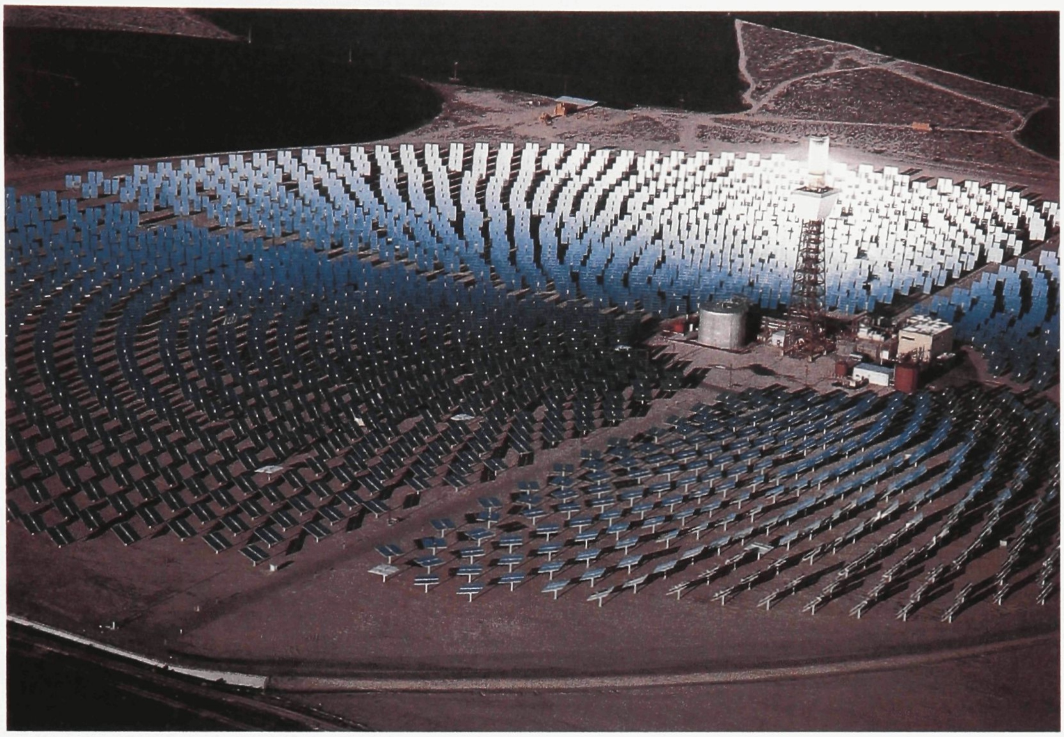

Fig. 7. *Solar Furnace*, Barstow, Califronia, 1996. Photograph by Alex S. MacLean.

Chapter 5: Sustainability

"Sustainability" in the context of this thesis, is seen as a physical balance between technological and organic systems in modernity, whereby the productive capacity of the technological system is able to continue and expand without degrading the vitality of the organic landscape. It is thus a measure aimed at limiting the extent to which technology affects organic nature negatively, and is seen as a way to reintegrate technological structures with the environment in a more positive manner.

Historical Form

The idea of sustainability is relatively new, having first been discussed at the United Nations Conference on the Human Environment in Stockholm during June 1972, where premises and principles were developed to help preserve the environment and human health, and to limit the effects of the technological structures against the organic landscape. To quote the sixth premise from the *Declaration of the United Nations Conference on the Human Environment*, the document that was published at the end of the conference:

> A point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences. Through ignorance or indifference we can do massive and irreversible harm to the earthly environment on which our life and well being depend. Conversely, through fuller knowledge and wiser action, we can achieve for ourselves and our posterity a better life in an environment more in keeping with human needs and hopes. [16]

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[16] United Nations Environment Programme, Declaration of the United Nations Conference on the Human Environment, 08 September 2005 <http://www.unep.org/Documents.multilingual/Default.asp?DocumentID=97&ArticleID=1503>.

As the preceding premise articulates, the initial concept of sustainability encouraged a lifestyle of environmental conservation that sought to curtail our dependences on technology by favouring less-technologically intrusive practices. As Adian Davison, a lecturer and writer on sustainability, remarks in his 2001 book, *Technology and the Contested Meanings of Sustainability*:

> The first wave of concern about environmental issues was deeply skeptical of the modernist model of progress and called for far-reaching spiritual, moral, and economic change in technological societies. It adopted a characteristically antigrowth position with respect to the orthodoxy of unlimited economic growth and technological modernization. [17]

Contemporary Form

While the initial principles were positive measures aimed at eliminating the prevalence of technological structures operating within society, they failed to reach social acceptance. Technological structures had become too intertwined within modernity to simply be abandoned. As a result, the idea of sustainability is now an institutional, theoretical and grassroots framework centered on balancing economic growth with ecological vitality.[18] While criticism may be leveled against contemporary notions of sustainability in that it fails to curtail technological dependence, I would argue that it is still a positive measure. We are tied to technologies we have created and the desire to "pull the plug" on technological use would hardly resonate in North America. The initial chaos of the 2003 electrical blackout and the ensuing return to peak electrical use

[17] Aidan Davison, Technology and the Contested Meanings of Sustainability, (Albany: State University of New York Press, 2001) 13.

[18] Davison 12.

underscores the extent to which we are dependent on technological structures in modernity.

Sustainability: Precedent

What is lacking, in my opinion, is the diffusion of sustainable technologies and principles throughout modern society. While such technologies exist they are relatively new in comparison to traditional technological systems and thus, unknown to a large majority of people. The wind turbine, the electric hybrid automobile, or the small-scale hydroelectric facility are only a few examples of sustainable technologies that are in use today, but for the most part, have escaped widespread social recognition and acceptance. To counter this paradox I believe that we must aggressively promote and use sustainable technologies, and locate them within urban areas, like the recently installed wind turbine at Exhibition Place on Toronto's waterfront. While this sustainable technology provides only enough electricity to power 250 homes in the area, its real value rests in its educational potential, as Steve Sottile states, "With any new technology you need to demonstrate it and familiarize it … This visible symbol of sustainable development is a reminder that there is an energy choice ... right there in front of six million people." [19] As the example of Toronto's sustainable alternative attests, sustainability can and must be diffused within our modern technological society. In this capacity it can actively contribute to continued function of our technological society, while ensuring that the organic landscape is not furthered degraded.

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[19] Jenna Young, "Wind Power Ruffles Feathers," The Online Reporter, 08 September 2005 <http://www.fims.uwo.ca/olr/apr903/windturbine.htm>.

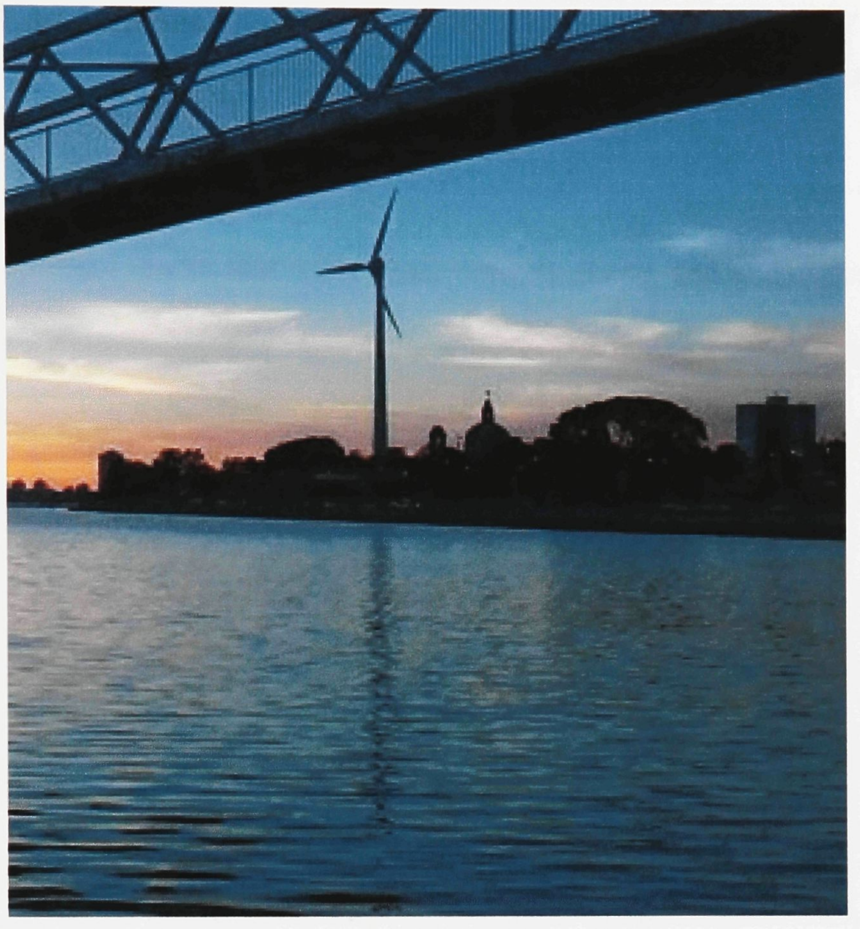

Fig. 8. *Sunset Over Water with Wind Turbine and Foot Bridge*, Toronto, Ontario, 2005. Photograph by Reimer Gaertner.

Chapter 6: Landscapes

Landscapes are places that individuals actively shape, and in that transformation construct either a desired scene or view, or a place that is in some way useful. As such it is both a verb and noun in the English language. Derived from the Germanic word *landschaft* of the early twelfth century, it initially referred to the "shape the land is in with respect to its customs, the material forms generated by those customs as law." [20] However, with the rise of landscape painting in 1420 it gradually became intertwined in the vocabulary of aesthetics. By the eighteenth century that relationship had been lost as the word landscape took on the prevailing pictorial ideas of the day. The initial notion of nature or physical space being formed through culture, technology and the environment had been displaced for the scenic and picturesque palate. In the prevailing aesthetic meaning, landscape became "detached from the life and work that a particular space embodied and implied" [21] as it was contrived for its harmonious and quaint setting. In this form the notion of the picturesque developed into pastoralism, which was a social response to the prevailing industrial and technological cultures that were beginning to develop. To quote Leo Marx, author of *The Machine in the Garden: Technology and the Pastoral Ideal in America*, a book that examines the relationship between technology and culture in 19th and 20th century America:

> What is attractive in pastoralism is the felicity represented by an image of a natural landscape, a terrain either unspoiled or, if cultivated, rural … a symbolic

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[20] David E. Nye, "Technologies of Landscape," Technologies of Landscape: From Reaping to Recycling, (Amherst: University of Massachusetts Press, 1999) 13.

[21] Nye, Technologies of Landscape: From Reaping to Recycling 13.

> motion away from centers of civilization toward their opposite, nature, away from sophistication toward simplicity, or, to introduce the cardinal metaphor of the literary mode, away from the city toward the country. [22]

In this displacement, the organic landscape, as a culturally perceived and physical modification of the natural environment, was polarized against the technological intrusions of the rapidly expanding industrial and consumerist culture. While pastoralism was a perceptual break from the unsympathetic machine, it nonetheless ironically reinforced humankind's dominating and exploitive tendencies towards the organic landscape. In the physiological construction of a desired natural scene or the physical creation of such landscapes through a careful selection and thinning of plant species, humans effectively idealized the natural environment. In doing so, the organic landscape remained a resource to be manipulated and controlled for future use.

Contemporary Form

As a measure of our cultural sensibilities and the way in which we interact and perceive the world around us, landscapes, especially those pertaining to the natural world, differ in meaning, value, and form across cultures. Residing within a highly technological society however, the organic landscape exists for the majority of North Americans as a mythic and idyllic setting. To offer an example we might consider the blasting of rock and the felling of trees in order to accept the Canadian VIA rail passenger car in the Canadian Rocky Mountains. The VIA passenger car – a definitive symbol of technological progress and might over the organic landscape – displaces and separates us farther from the field we are transgressing. Any opportunity to actively engage and

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[22] Leo Marx, The Machine in the Garden: Technology and the Pastoral Ideal in America, (New York: Oxford University Press, 1964) 9.

understand the organic is lost in the desire for quick transit or the framing of a desired view through the windowpane of the railcar. As David E. Nye, a professor and writer on technology in American culture and society, elaborates in his text, *Consuming Power: A Social History of American Energies* from 1998:

> Railway travel refocused the eye on the distance, and travelers lost touch with the landscape's sounds, smells, and textures. The traveler was isolated from the passing scene and could easily fall into a reverie, feeling that the train was stationary while the landscape rushed by. People in the landscape glimpsed from the train "struck passengers not as individuals but as type[s]." Railway travel inculcated a taste for the picturesque view, presenting the traveler with occasional panoramas, a few of which were deemed worthy of artistic representation. The local and the particular disappeared from the traveler's experience. This editing of the landscape, seen through the windows or railway cars that were shaped like picture frames, transformed the journey into an opportunity to see a set of distinct tableaux.[23]

Suburbia also reinforces our compulsive desires to order the organic landscape. Sitting atop riding lawnmowers we fashion a constructed nature that is controlled through weekly cutting, constant watering and large-scale pesticide and fertilizer use. As Alexander Wilson, a horticulturist and journalist who wrote extensively on popular culture and the environment, states in *The Culture of Nature: North American Landscapes from Disney to the Exxon Valdez*, "This is an activity that ends up integrating the body into a mechanistic view of nature." [24] Furthermore, the site of the suburban home is a horizontal plane with little or no indication of natural terrain. Bulldozers and other technological structures have leveled and cleared the land in a deliberate act of control. To quote Robert Thayer, it is a "landscape forged of practical necessity by the

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[23] David E Nye, Consuming Power: A Social History of American Energies, (Cambridge: The MIT Press, 1998) 73.

[24] Alexander Wilson, The Culture of Nature: North American Landscapes for Disney to the Exxon Valdez, (Toronto: Between the Lines, 1991) 97.

operative technologies of modern life."[25] It is in this form that I would characterize the contemporary landscape: a place of increasing technological sophistication and acceptance but one nonetheless predicated on the continued degradation of the organic landscape.

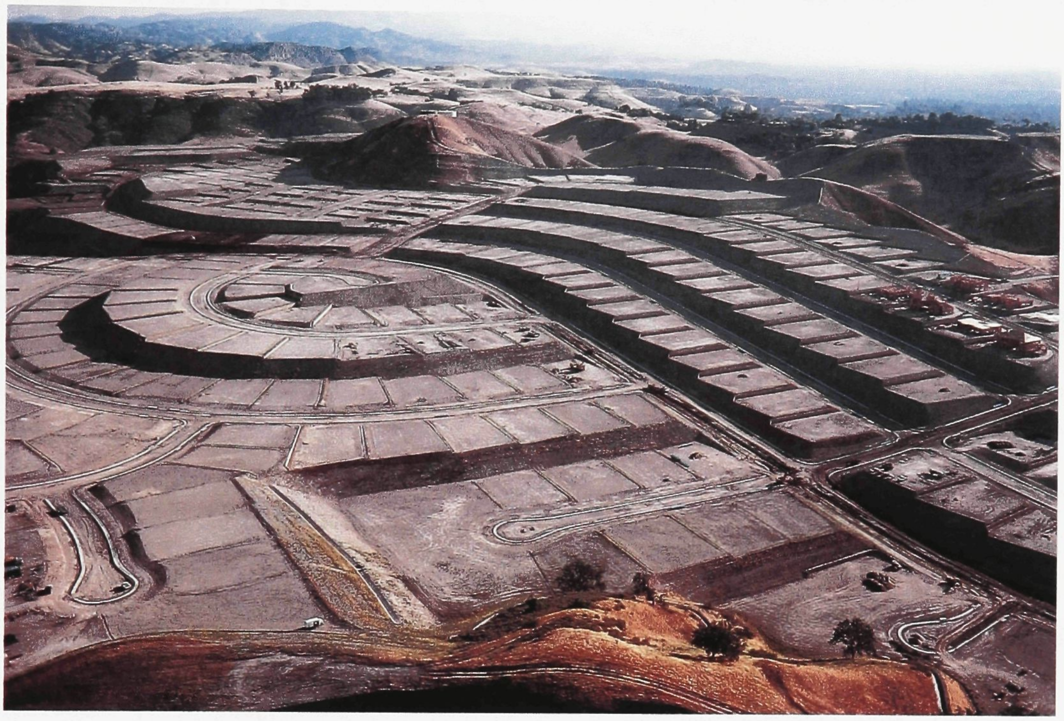

Fig. 9. *Earthworks for Hillside Housing*, Los Angeles, California, 1996. Photograph by Alex S. MacLean.

Sustainable Landscapes: Conceptual Development

Amid the physical and psychological divide of contemporary landscapes however, there exists a growing consciousness aimed at restructuring our association with landscapes. James Corner, a preeminent landscape architect and theorist, has critically argued that landscapes should reshape "the world not only because of its physical and experiential characteristics but also because of its eidetic content, its capacity to contain

[25] Thayer 104.

and express ideas and so engage the mind."[26] Articulated in his book, *Recovering Landscapes: Essays in Contemporary Landscape Architecture* from 1999, Corner underscores the political, social and physical dimensions of landscapes and thus, their capacity to act as "an active instrument in the shaping of modern culture."[27] In this regard landscapes may begin to establish a collective subjectivity and give communities a certain identity and meaning reflecting individual stories and events. The organic landscape as a facet of the contemporary landscape is thus "less that of scenery, greenery, wilderness, and acardia and more that of a pervasive milieu, a rich imbroglio of ecological, experiential, poetic, and expressively *living* dimensions."[28] It is in this reconfigured form that I characterize the *sustainable landscape.*

Sustainable Landscapes: Precedent

The sustainable landscape is a place that balances the vitality of the organic landscape against the technological structures of modernity, in a manner that promotes and addresses a retrieval of memory and place; technological program and utility; and environmental responsibility and growth. To offer a precedent on its development and implementation we might consider Peter Latz's Duisburg-Nord Landscape Park, a 230-hectare park that was completed between 1990 and 1999 in Germany's heavily industrialized Ruhrgebiet or Ruhr area. In this post-industrial redevelopment project, aging industrial artifacts have been re-appropriated towards a public engagement. Mildly

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[26] James Corner, "Recovering Landscape as a Critical Cultural Practice," Recovering Landscape: Essays in Contemporary Landscape Architecture, (Princeton: Princeton Architectural Press, 1999) 1.

[27] Corner 1.

[28] Corner 13.

contaminated soil is bio-remediated through natural organisms and purposefully selected vegetation, and polluted water is cleaned and treated through technologies such as the windmill. The project, which was the result of an international competition, sought to reclaim industrial land through organic nature, rather than a leveling and clearing of the site through a planned landscape design. [29]

Fig. 10. *Landscape Park Duisburg-Nord*, Ruhrgebiet, Germany, 2001. Photograph by Christa Panick.

[29] Peter Latz, "Landscape Park Duisburg-Nord: The Metamorphosis of an Industrial Site," Manufactured Landscapes: Rethinking the Post-Industrial Landscape, ed. Niall Kirkwood, (New York: Spon Press, 2001) 150.

The resulting sustainable landscape is one of formal and informal vegetation, industrial architecture, and social interaction. All the existing and fragmented industrial structures are preserved and in some instances, have been re-appropriated to facilitate new programs and uses. Rail lines are now cycling paths, while the gasometer (a cylindrical gas storage facility) permits scuba diving. The blast furnaces have become accessible elements that allow the public visitor to climb and wander through aging industrial components, while the on-site materials have been recycled into new forms such as footbridges and handrails. Complementing these transformations to the industrial or technological object are spaces for public gathering, restaurants and accommodation, and art exhibits, such as lighting displays that "transform the structures and spaces into hypnotic animated creatures." [30]

Even though sustainable landscapes have yet to become integral and visible parts of the urban realm, Duisburg-Nord shows that organic nature can be coupled with technological structures in the creation of healthy and socially accepted places. While Peter Latz chose to limit the extent of new sustainable technologies introduced to the site (predominately due to a restrictive budget), he nonetheless helped to demonstrate the "diffusion of environmentally and socially sustaining principles into common usage in the everyday world." [31] Working from the precedent established by the Latz, I have in turn developed a sustainable landscape for the architectural/landscape component of this thesis investigation. This is articulated through the creation of a publicly accessible, small-scale hydroelectric facility that generates and distributes "green" or renewable

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[30] Brenda J. Brown, "Reconstructing the Ruhrgebiet: Ruins, a River, and Leftover Lands," Landscape Architecture April 2001: 72.

[31] Thayer 309.

electricity back to Ottawa, while surrounded by a park of canals, rock and soil beds, organic areas and path systems.

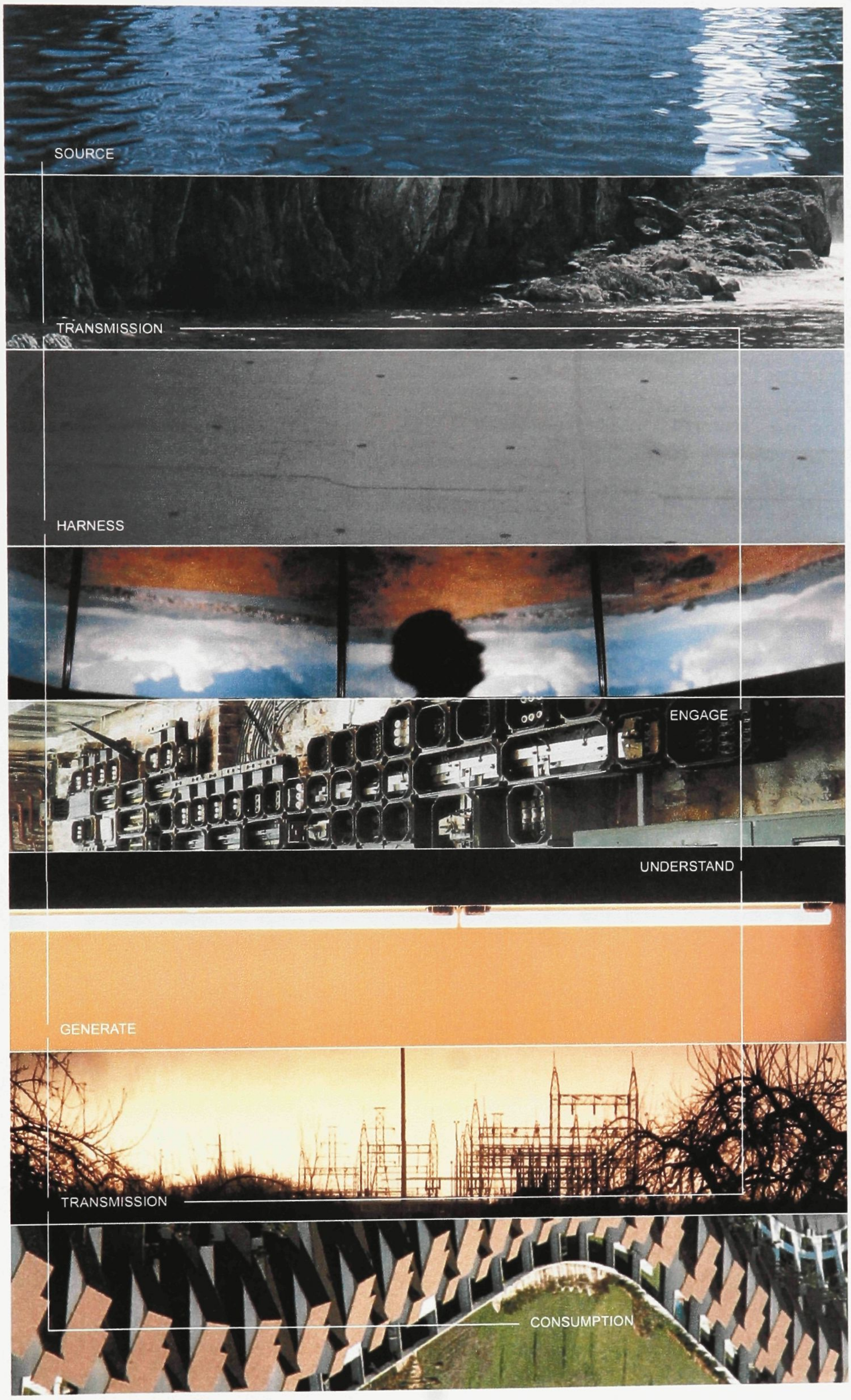

Fig. 11. *Reflections on Technology,* digital collage, 2004. Created by author.

Part III

Project

Chapter 7: Hydroelectric Power Generation

Hydroelectric stations generate electricity by capturing the energy of falling water. As water drops, the kinetic energy stored in the moving water is transformed into mechanical energy, which can then be converted into electrical energy through the different operations of the hydroelectric station. While no hydroelectric facility is the same they can nonetheless be grouped into four categories depending on their generating capacity: micro, mini, small and large scale. Micro facilities generate approximately 100 kW of electricity or less and thus, tend to be used to provide power for individual homes. Mini facilities generate between 100 kW to 1 MW (1000 kW) of electricity and can be used to support a small community or factory. Small facilities generate between 1 MW to 30 MW of electricity and can help support a regional power grid. Finally, large facilities generate in excess of 30 MW of electricity and thus, provide a large amount of the electricity we use daily. [32]

Electricity is measured in units of power called watts (W), which is equivalent to burning 1 joule of energy per second. Since the watt is too small to power any modern technological device by itself, it is often grouped to form a larger kilowatt (kW), which is 1,000 watts, or a megawatt (MW), which is 1,000 kilowatts. For the purposes of determining electrical use, the kilowatt becomes the kilowatt-hour (kWh). The kilowatt-hour is determined by multiplying the power requirements of a technological device by the number of hours it is used. For example, if you use a 40 W light bulb for five hours a

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[32] National Resources Canada, Small-scale Hydro, 26 October 2004 <http://www.canren.gc.ca/tech_appl/index.asp?CaId=4&PgId=277>.

day, you have used 200 watts of power, or 0.2 kilowatt-hours of electrical energy. The average Canadian home uses approximately 886 kWh of electricity per month, which translates to 1.2 kWh of electricity per hour. Thus, a small hydroelectric facility generating 2 MW of electricity can provide 2,000 kWh of electrical energy or enough electricity to power 1,667 homes.

Canadian Statistics

In Canada, hydroelectric power accounts for approximately sixty percent of the total amount of electricity generated with most of this energy coming from large-scale hydroelectric facilities. In total there are approximately 450 hydroelectric facilities in operation with about 200 of those classified as small-scale. [33] The majority of these stations are located in Quebec, Ontario, Manitoba, British Columbia and Newfoundland and Labrador where there are abundant rivers and the topography is quite varied. In the developed world, Canada is the leader in hydroelectric production with a total generating capacity of 67,121 MW as of 2002. There is also an estimated 182,832 MW of hydroelectric potential in the country, of which 34,371 MW can be considered economically, technically and environmentally practical in relation to construction. [34]

Construction

In order to construct a hydroelectric facility there has be a sufficient change in elevation and a source of water. This elevation change provides the momentum to

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[33] National Resources Canada, About Hydroelectric Energy, 26 October 2004 <http://www.canren.gc.ca/tech_appl/index.asp?CaId=4&PgId=266>.
[34] National Resources Canada, About Hydroelectric Energy, 26 October 2004 <http://www.canren.gc.ca/tech_appl/index.asp?CaId=4&PgId=266>.

transform the kinetic energy of the moving water into the mechanical energy required for electrical production. To determine the capacity of the proposed facility the equation P = eHQg is used where: P = electric power output in kilowatts (kW); e = efficiency range 0.75 to 0.88 (small-scale hydroelectric facilities are usually .81); H = head or drop in elevation in metres (m); Q = design flow in cubic/metres/sec (m^3/s); and g = acceleration of gravity (9.81m/s/s). Thus for the small-scale hydroelectric facility with an efficiency of 81% the equation will read: P (kW) = 7.95 x H (m) x Q (m^3/s). [35]

Technological Components

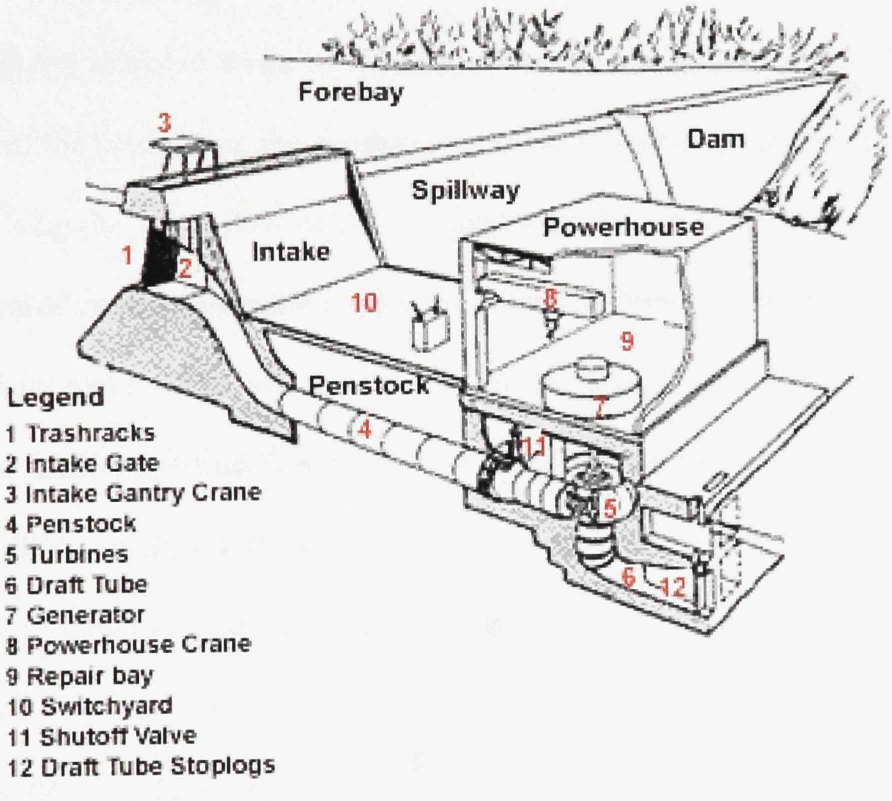

Fig. 12. *Schematic sectional view of a medium head hydroelectric facility.* [36]

[35] National Resources Canada, Calculating Electrical Power, 26 October 2004 <http://www.canren.gc.ca/tech_appl/index.asp?CaId=4&PgId=271>.
[36] National Resources Canada, About Hydroelectric Energy, 26 October 2004 <http://www.canren.gc.ca/tech_appl/index.asp?CaId=4&PgId=266>.

The main component of the hydroelectric facility is usually the dam, which controls the amount of water entering the facility and the height at which the water falls. Constructed of concrete or earth it can be classified as either a storage or barrage dam. Storage dams, which are predominately used in large-scale applications, impound water in order to create a reservoir for hydroelectric generation. The increased water level improves the generating capacity while insuring a reliable supply of water for the hydroelectric facility. Barrage dams on the other hand have operable gates to control the level of the water in the reservoir and thus, have a limited storage capacity. These qualities make it particularly suitable for small-scale applications where there is limited space for reservoir flooding. [37] As a barrier to the flow of the water the dam helps channel water through the intake, a series of openings located below the water level. The constriction of the water from the forebay or reservoir located behind the dam into the intake, speeds up the water flow, which coupled with the change in elevation at the site of the dam, ensures greater generating capacity. Controlled through inlet valves it determines how much water will enter the system. In the case of the small-scale hydroelectric facility operating on a run-of-the-river system this means that the intake will work with the watercourse by allowing all the water to flow through. This ensures that no water remains stagnant in the forebay as it would in large-scale facilities. While the water flows through the intake opening unobstructed, large debris such as branches that might be floating in the water need to be blocked from entering the system. This is achieved through trashrakes, which are metal screens situated over the intake. The intake gantry crane, which is situated on the top of the dam structure, removes any debris that

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[37] Gregory L. Morris, and Jiahua Fan, Reservoir Sedimentation Handbook: Design and Management of Dams, Reservoirs, and Watersheds for Sustainable Use, (Toronto: McGraw-Hill, 1998) 3.4.

might be blocking the movement of water through the system. In addition to the intake the dam is constructed with a spillway. This opening located at the height of the water level behind the dam allows high water levels to pass over the dam without compromising the structure of the dam or the safety of those behind it. [38]

Once the water has entered the intake it is carried to the turbines through a tunnel called a penstock. This chamber is the link that connects the generating station or powerhouse to the dam and is a vital component in maintaining the speed at which the water is traveling. Located within the powerhouse the turbines transform the kinetic energy of the moving water into mechanical energy. As the water falls through the propellers of the turbine its force turns the blades and the shaft, which is then transformed into electrical energy by the generator. Turbine designs conform to three types: an impulse turbine (Pelton Turbine), an axial flow (Propeller Turbine), and a radial flow (Francis Turbine). Each model has different characteristics and is selected by the engineer based on the rate of water flow, the height the water falls and the speed it rotates. The rotation speed of the shaft is particularly important, as the generator, which converts the mechanical energy into electrical energy, must rotate at the same speed.

In addition to the generators and turbines, the powerhouse also has areas designated for repairs and a crane that can be utilized to lift and place heavy objects requiring maintenance. In the event such repairs are necessary the penstock can be closed with a shutoff valve to stop the flow of water through the system. At the end of the

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[38] National Resources Canada, About Hydroelectric Energy, 26 October 2004 <http://www.canren.gc.ca/tech_appl/index.asp?CaId=4&PgId=266>.

hydroelectric process is the draft tube that transfers the water back to the river after it has spun the turbines. The area in which it leaves the facility is known as the tailrace. [39]

Fig. 13. *Understanding Hydroelectric Equipment: Pelton, Propeller and Francis Turbines.* Photographs by National Resources Canada.

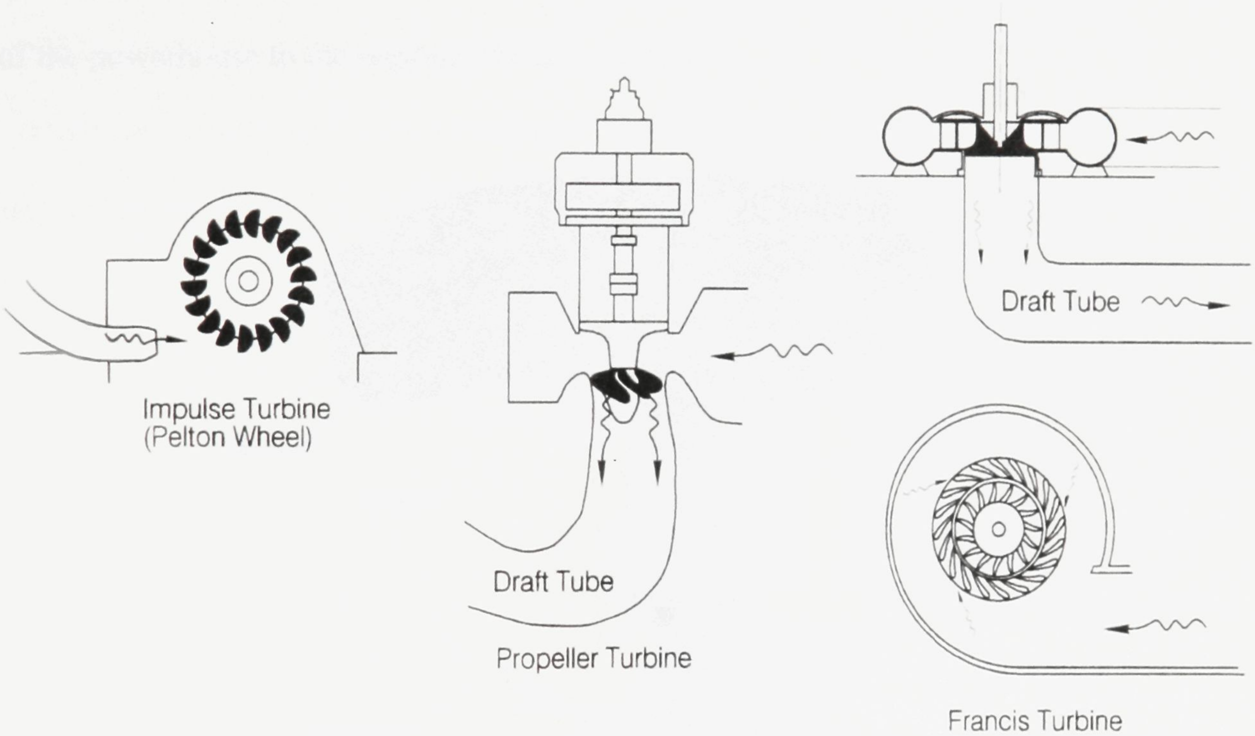

Fig. 14. *Types of Hydropower Turbines.* Drawings by Gregory L. Morris and Jiahua Fan.

[39] National Resources Canada, Understanding Hydroelectric Equipment, 26 October 2004 <http://www.canren.gc.ca/tech_appl/index.asp?CaId=4&PgId=1154>.

Generation of Electricity

Generators are situated within the powerhouse and contain four main components that transform the mechanical energy into electricity. These parts include the shaft, excitor, rotor and stator. As previously mentioned, the shaft is the component that draws the rotation of the propellers up towards the generator. This rotation causes the excitor to send an electrical current to the rotor (a series of electromagnets situated within the stator) causing them to spin. As the electromagnets spin against copper wire wound along the inside of the stator, a magnetic field is created with an alternating AC current. This current is then converted to a higher voltage through a transformer, which is then sent out of the powerhouse to the regional electrical grid.

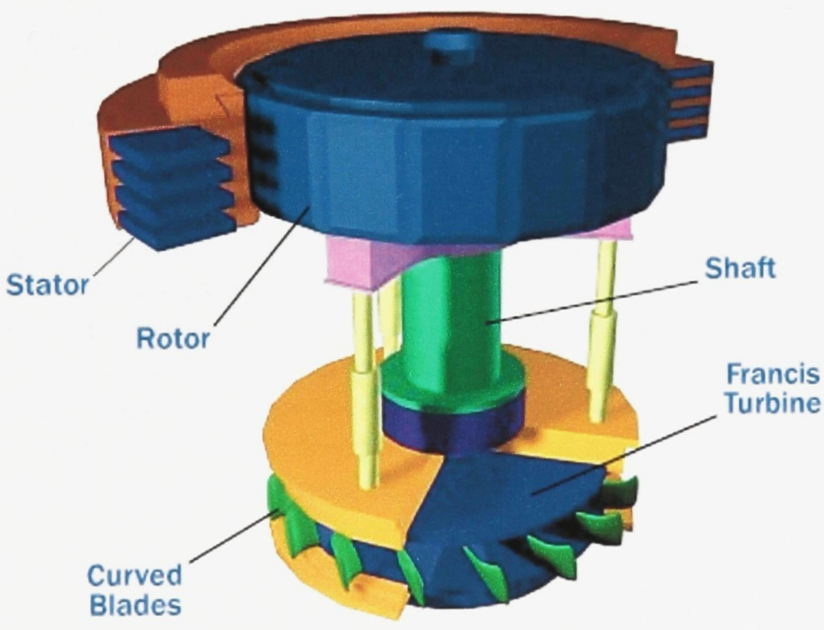

Fig. 15. *Inside a Hydropower Plant Generator.* Computer model by Kevin Bonsor.

Environmental and Social Implications

While hydroelectric power can be considered a renewable energy by utilizing the natural force of water and emitting little or no harmful emissions, it must be noted this claim is not without controversy. Dams and large-scale hydroelectric facilities in particular, can have a significant impact on both the organic landscape and human populations. With the construction of a dam the natural state of a river is altered. The imposing barrier curtails the water flow and the increasing water level of the reservoir inundates the surrounding areas making them otherwise unusable. Aquatic organisms such as fish cannot spawn upstream with a dam in place, and the change in water flow and sediment deposition can negatively impact biodiversity. Patrick McCully, the Campaign Director for the International Rivers Network in Berkeley, California and an associate editor of *The Ecologist*, captures these sentiments in his text, *Silenced Rivers: The Ecology and Politics of Large Dams*, when he states:

> Nothing alters a river as totally as a dam. A reservoir is the antithesis of a river – the essence of a river is that it flows, the essence of a reservoir that it is still. A wild river is dynamic, forever changing - eroding its bed, depositing silt, seeking a new course, bursting its banks, drying up. A dam is monumentally static; it tries to bring a river under control, to regulate its seasonal pattern of floods and low flows. A dam traps sediments and nutrients, alters the river's temperature and chemistry, and upsets the geological processes of erosion and deposition through which the river sculpts the surrounding land. [40]

In this critique of hydroelectricity, McCully addresses the political framework from which dams are constructed and how they can act as a controlling device over local populations. In particular he identifies the wide-ranging ecological impacts and human

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[40] Patrick McCully, Silenced Rivers: The Ecology and Politics of Large Dams, (London: Zed Books Ltd., 2001) 10.

consequences of constructing large dams. With the creation of the Three Gorges Dam in China for example, over one million men and women have been forced to relocate to higher ground, as entire cities have been demolished to make way for the largest hydroelectric facility in the world. As a result, McCully positions hydroelectric generating sites as an "unsustainable potentially renewable" technology, that "cannot seriously be considered a 'clean' energy source: the pollution caused by dams may be less obvious than the dirty columns of smoke belching from coal-burning plants, but it is pollution none the less."[41]

Fig. 16. *Glen Canyon Dam*, Colorado River, Arizona, 1996. Photograph by Alex S. MacLean.

While I agree with McCully that hydroelectric generating sites have the potential to negatively impact the environment, such sentiment I would argue, is only applicable towards large-scale facilities. Small-scale hydroelectric facilities are a sustainable technological structure that utilize a renewable resource without emitting any greenhouse

[41] McCully 140.

gases or pollutants back into the atmosphere. With little or no reservoir flooding they limit the extent to which human and animal populations will be affected by the creation of a dam. Similarly, operating under a "run-of-the-river" system, whereby no water remains held behind the dam for storage or irrigation purposes, the hydroelectric facility maintains the flow and thus, balance of the river ecosystem. From an operational perspective, their small size reduces maintenance, fuel and worker expenses, and since the physical parameters for hydroelectric generation are historically proven, dating back to 1881 in Canada, the stations themselves can be used for long periods of time without the costly upgrades and refurbishments that plague coal and nuclear stations.

Hydroelectricity in Ottawa

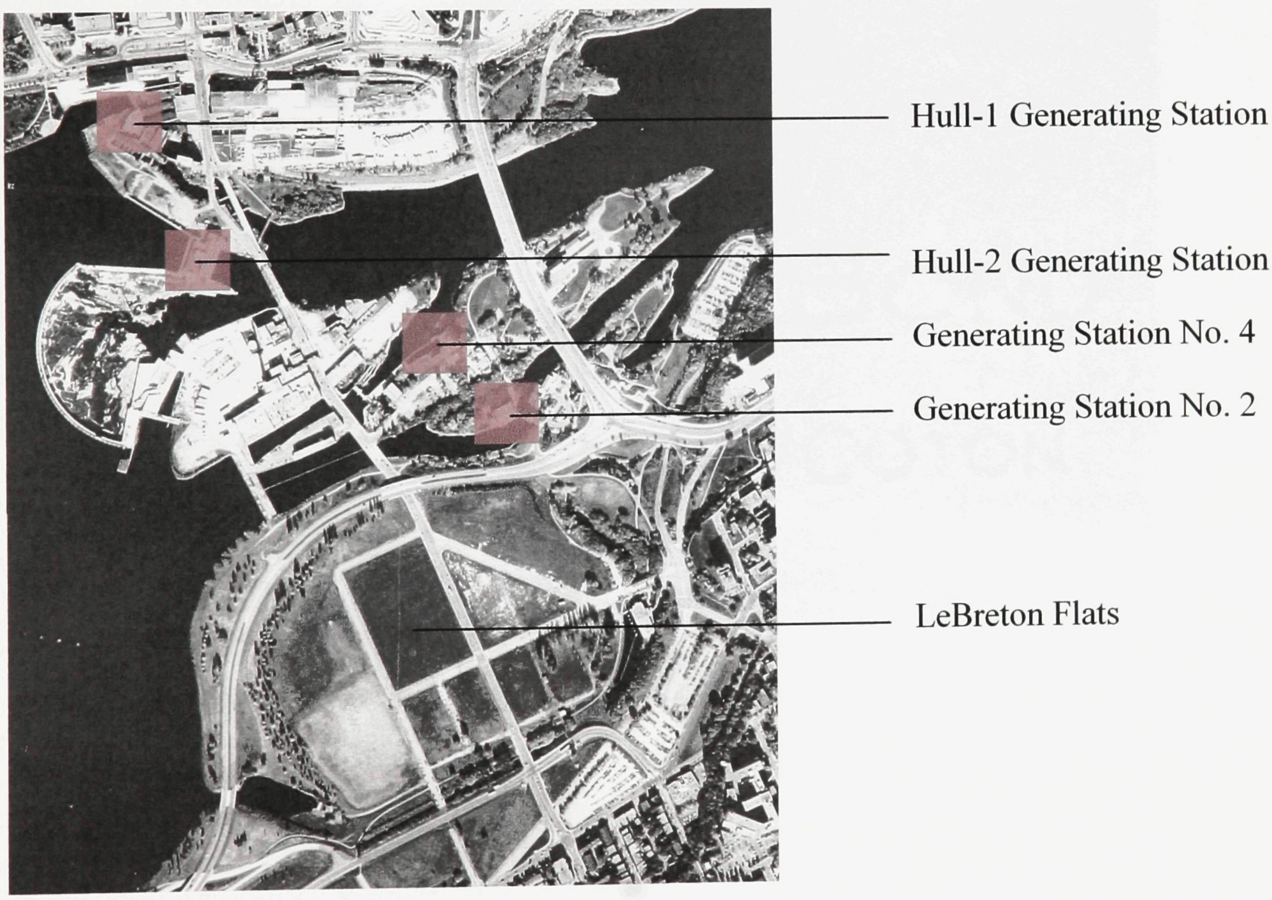

Fig. 17. *Hydroelectricity in Ottawa*, Ottawa, Ontario, 2002. Arial Photograph by National Resources Canada.

Small-scale hydroelectric dams are deeply imbedded in the history of the Ottawa River. First used in the early nineteenth century to move water across the saws of lumber mills, the dams have now been transformed to generate electricity. Currently there are four hydroelectric dams operating within the Ottawa River that provide Ontario and Quebec with electricity. Two of those structures are tied to Hydro Quebec, while the two dams located closest to the Ontario border are owned and operated by Energy Ottawa, a local energy company that provides electricity generated through renewable means and hot water services to the city of Ottawa. [42]

Fig. 18. *Generating Station No. 2*, Ottawa, Ontario, 2004. Photograph by author.

[42] Energy Ottawa, Green Power-Generating Stations, 26 October 2004 <http://www.energyottawa.com/green_power/index.cfm?dsp=template&act=view3&template_id=152&lang=e>.

Dating back over one hundred years, the two Ontario generating stations are historical markers of our interaction with and effect on the organic landscape. Generating Station No. 2, which generates 4,386 MW of electricity, was originally built in 1891 for use as a grist mill. While turbines were later added in 1897 by the Ottawa Electric Company the modern generating process continues to operate within the confines of the historical structure. Generating Station No. 4 operates in a similar context providing 7,920 MW of electricity today but from a structure constructed in 1900. Recently the two stations have been upgraded to conform to modern generation strategies and as a result, they can now generate 12,306 MW of "green" electricity combined (green electricity is power that is generated though renewable means and emits no harmful pollutants back into the organic landscape). Similarly, they operate under a "run-of-the-river" system where the natural flow of the Ottawa River is decanted through the generating stations and back out to its original course without being held in a reservoir setting prior to generation. [43] It is a sustainable model that provides a modern technological necessity without compromising the organic landscape, and as such, is a fitting precedent from which to structure the technological parameters concerning the development of a new small-scale hydroelectric facility on LeBreton Flats.

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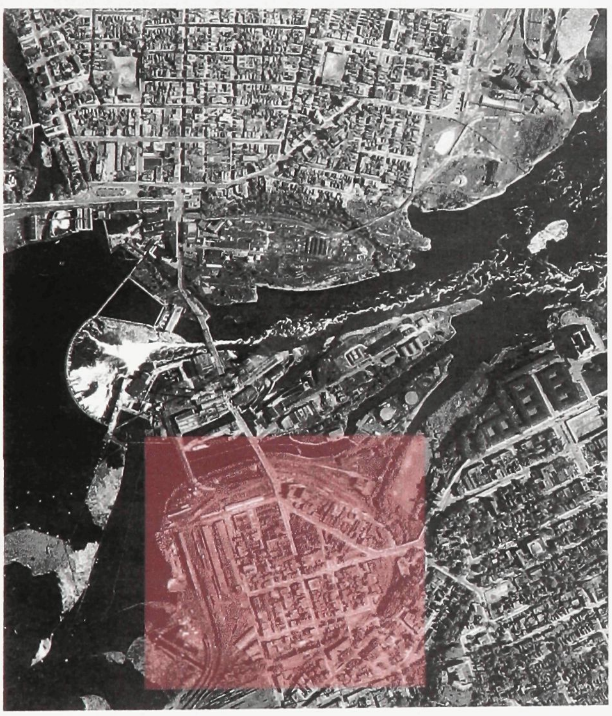
[43] Energy Ottawa, Green Power – Fast Facts, 26 October 2004 <http://www.energyottawa.com/green_power/fast_facts.cfm?dsp=template&act=view3&template_id=150&lang=e>.

Chapter 8: LeBreton Flats

LeBreton Flats, a sixty-four hectare site located in Ottawa beside Confederation Boulevard and the Ottawa River is emblematic of the cultural dichotomy existing between organic nature and technological structures. As a historical site it figured prominently in the growth of Ottawa from a small lumber community in the nineteenth-century to its present status as national capital. In 1962, however, the federal government expropriated the community and intentionally cleared the site to facilitate government and institutional expansion along the scenic Ottawa River. For forty years LeBreton Flats remained vacant as vested interests clashed over its future redevelopment potential. [44]



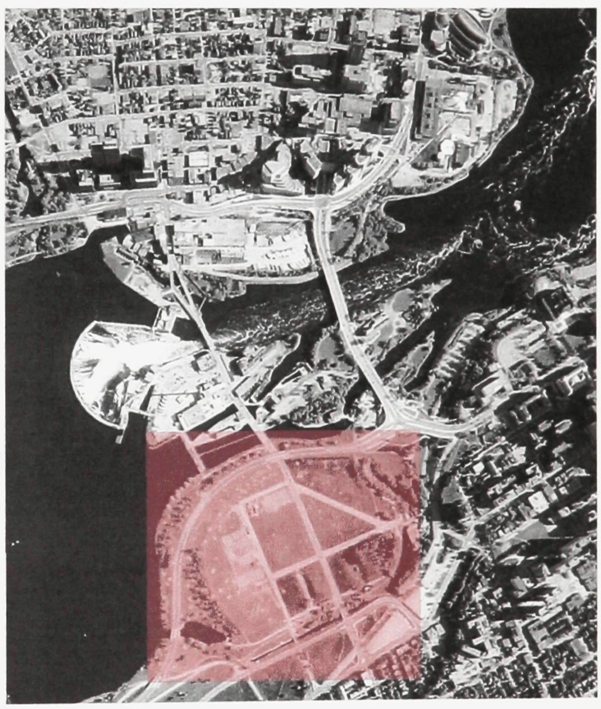


Fig. 19. *Historical LeBreton Flats*, Ottawa, Ontario, 1950. Arial Photograph by National Resources Canada.
Fig. 20. *Contemporary LeBreton Flats*, Ottawa, Ontario, 2002. Arial Photograph by National Resources Canada.

[44] Phil Jenkins, An Acre of Time, (Toronto: Macfarlane Walter & Ross, 1996) 180.

Historical Form

LeBreton Flats, in its historical form, was defined by a close relationship shared between the organic landscape and technology. The building of dams and industrial mills along the currents and rapids of the Ottawa River powered turbines and saws, and in the process, provided both material wealth to the rising capitalist economy, and a sense of progress to the workers who toiled against and with the natural elements. The organic landscape in this context enabled technological "progress" while the technological intrusions onto the site paved the way for settlement and expansion into what would eventually comprise the National Capital Region. In this sense, any physical transgression onto the organic landscape was justified as contributing to a larger cultural development within the Flats.

Enhanced through a diverse working class population of families, tradespeople and proprietors, the Flats were a "focus of pulsating urban life" where "the streets were lined with houses, hotels, bars and stores; people sat on front porches; children played in the street; and jobs were nearby in the rail yards and small factories." [45] By dwelling on the site the inhabitants further inflicted LeBreton Flats with an accumulating history of personal and collective experiences. Augmenting an already existing material and natural wealth on the site, history thus imbued LeBreton Flats with a rich and diverse cultural wealth.

In 1962 however, the federal government expropriated the 2,800 residents and demolished any building standing on the site. As a reductive gesture aimed at eliminating social perceptions of the community, the technological intrusion onto the natural and

[45] Maria Cook, "Field of Dreams," Ottawa Citizen 15 May 2004: E4.

cultural fabric of LeBreton Flats transformed the site from a vibrant community to an empty and contaminated field. What was added to the site was the concession that technology and political operative could act against both a physical landscape and group of people.

Fig. 21. *LeBreton Flats: 1923*, Ottawa, Ontario, 1923. Arial Photograph by National Resources Canada.

Contemporary Form

In its present state, LeBreton Flats is controlled by the National Capital Commission (NCC), a crown corporation responsible for the maintenance and development of federal land in the Capital region. Under its direction the site has finally begun to be redeveloped and will slowly be inhabited with the construction of housing and commercial units, institutions and an extensive park setting following the removal of the contaminated earth. As a process that will span decades it will see the gradual transformation of LeBreton Flats into an urban community supported by new infrastructure, pedestrian linkages and green space. As a NCC report on the redevelopment of LeBreton states: "One of the key components of the new vision for LeBreton Flats is to reclaim for Canadians one of the last and most beautiful waterfront sites in the nation's capital." [46]

Fig. 22. *LeBreton Flats Master Redevelopment Plan,* watercolour rendering, 2004. Created by National Capital Commission.

The proposed redevelopment consists of residential and commercial buildings adjacent to the aqueduct, and spreading north to the realigned Wellington Street, which now cuts diagonally across the middle of the site. Across this multi-lane road is a large green space that acts as a recreational and festival space, while creating a buffer between the buildings and recently completed Canadian War Museum. Branching off the principal

[46] Cook E4.

roads (Wellington and Booth Street) is a series of smaller support roads that provide access to the new residences, offices and stores. Finally, within interior courtyards, at the front of buildings and along the aqueduct and Ottawa River shoreline are a series of interconnected green spaces. These spaces are in turn linked through cycling and pedestrian paths.

Fig. 23. *LeBreton Flats Redevelopment: Phase I Conceptual Design Proposal,* watercolour rendering, 2004. Created by Dan S. Hanganu & Associate Architects, and Daoust Lestage Inc.

As the National Capital Commission has discovered in redeveloping the site however, past actions can become "expensive" mistakes. Coupled with the loss of the vibrant community, LeBreton Flats has seen $99 million dollars spent on the remediation of the soil that was contaminated in the demolition of the industrial buildings in 1962. To ensure that the new architecture and park settings developed are free of hazards and that in their construction none of the contaminates leech into the Ottawa River or the aqueduct crossing the site (which supplies drinking water to the city), all soil to the bedrock has been removed. While this costly expenditure is vital in redeveloping the Flats as a habitable environment and ensuring that adjacent ecosystems are not endangered, it has nonetheless seen the removal of over 600,000 tonnes of contaminated soil and its placement at a secondary location outside of the city proper. [47]

Reflections on LeBreton Flats

Fig. 24. *Reflections on LeBreton Flats*, graphite rendering, 2004. Created by author.

Being out of site and out of mind, the reduction of natural earth on the Flats and the movement of the contaminated earth to another location have in essence removed the final layer of "guilt" that began with the 1962 expropriation. Similarly, the layers of history and memory contained in that very soil have been removed from the site and have

[47] Cook E4.

site reveals its past through its form and the retained soil. This is particularly apparent in the collection of infrastructure systems, specifically road networks, which are either still in use or can been seen as trace elements on the site. While road infrastructures are only a minor component in a century of development on the Flats, they nonetheless reveal the extent to which the site has been inhabited, transgressed and ultimately forgotten. Similarly, as an infrastructure system they have the potential to "mediate between architecture and landscape in order to contribute to the reconceptualization of the urban realm." [49]

Fig. 25. *The Archimedes Palimpsest*. Photographer and date unknown. [50]

[49] Anita Berrizbeitia, and Linda Pollak, Inside Outside: Between Architecture and Landscape, (Gloucester, Massachusetts: Rockport Publishers, Inc., 1999) 152.

[50] The Archimedes Palimpsest, Greek Sources I, 02 September 2005 < http://www-groups.dcs.st-and.ac.uk/~history/HistTopics/Greek_sources_1.html>.

To *reveal* this history and connect the contemporary sustainable landscape to its past, three maps of LeBreton Flats (1950, 1994 and 2004) were layered over one another to create a palimpsest of the site's infrastructure history. The resulting traces form the parameters for the siting of the sustainable landscape. Thus, any change to the site or the ensuing architectural/landscape development is located off important junctions in the history of LeBreton Flats, while working with the organic landscape in a reciprocal manner. Specifically, the five sequential architectural/landscape design developments outlined in Chapter 9: The Sustainable Landscape, namely the canals, rock and soil beds, organic areas, path systems and the hydroelectric facility, are situated by way of the infrastructure layers formed in the palimpsest map.

LeBreton Flats: 1950

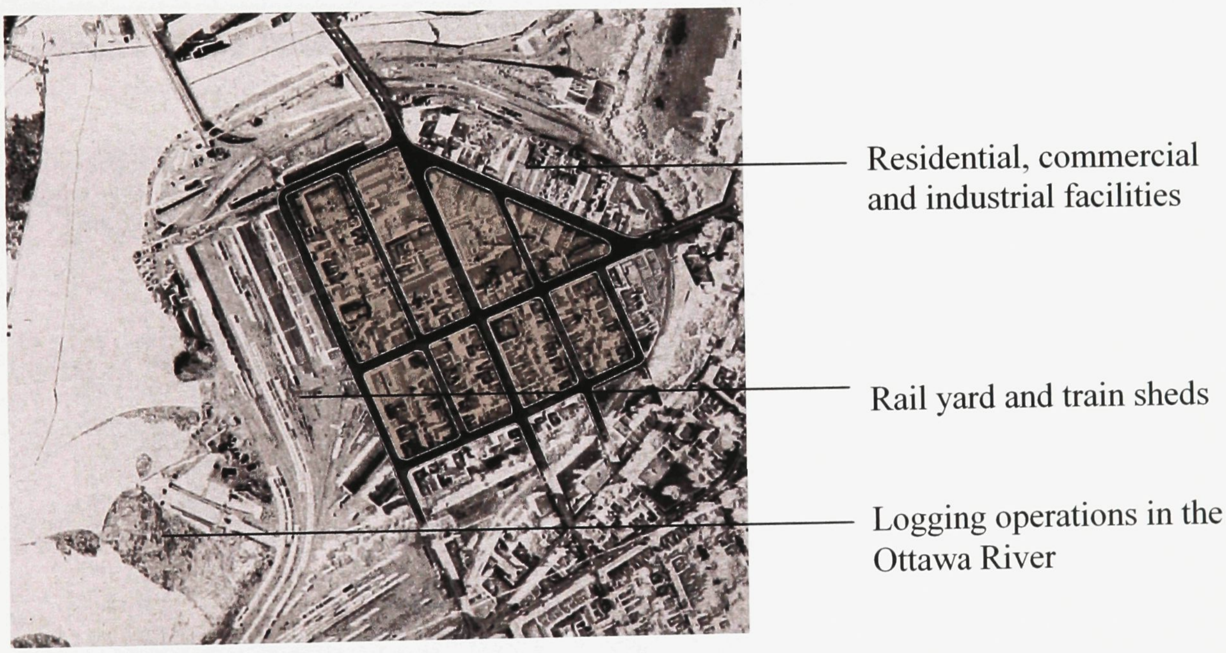


Fig. 26. *LeBreton Flats: 1950,* digital collage, 2005. Arial Photograph by National Resources Canada.

LeBreton Flats: 1994

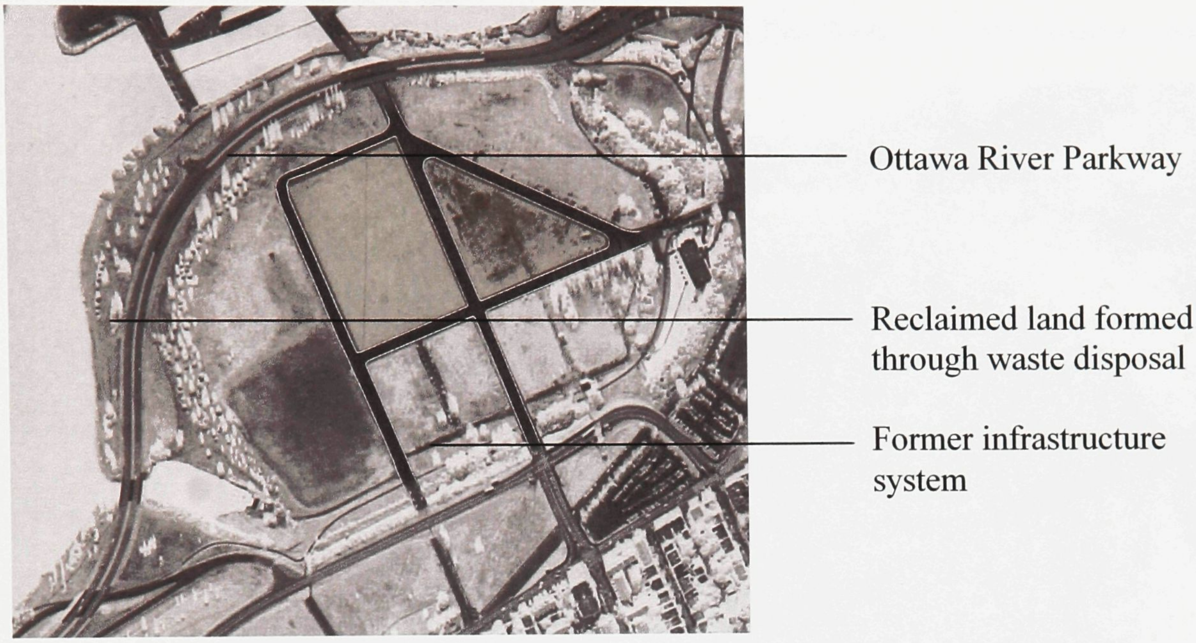


Fig. 27. *LeBreton Flats: 1994,* digital collage, 2005. Arial Photograph by National Resources Canada.

LeBreton Flats: 2004

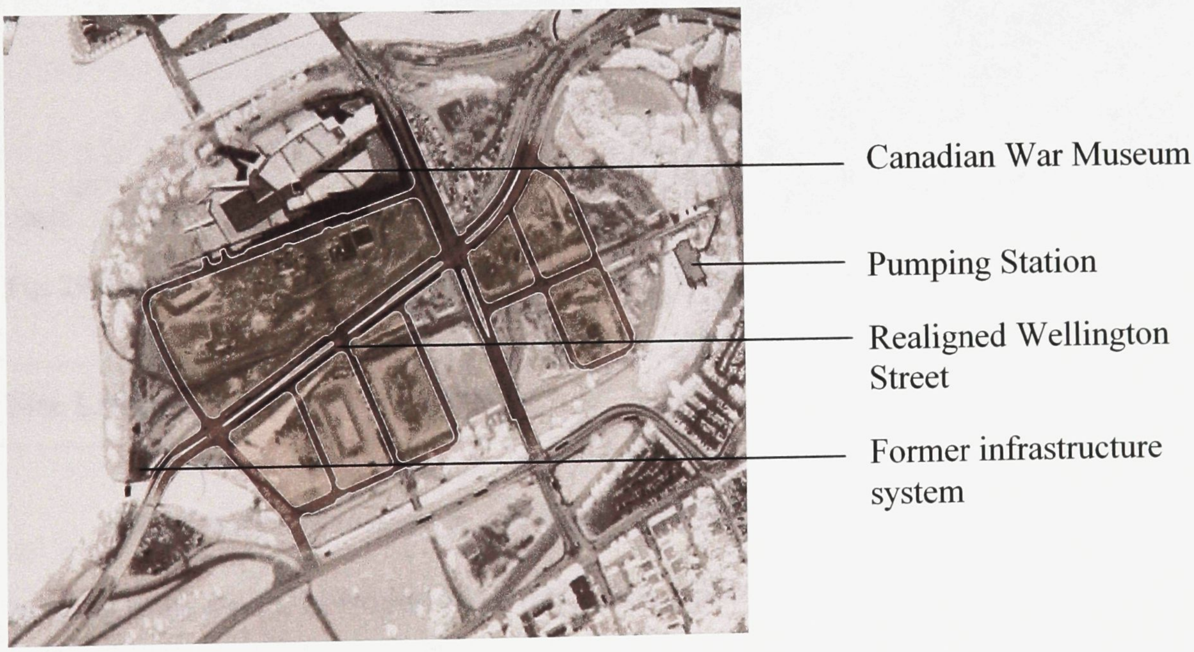


Fig. 28. *LeBreton Flats: 2004,* digital collage, 2005. Arial Photograph by National Resources Canada.

Palimpsest Map

1. Canals 2. Rock and Soil Beds 3. Organic Areas 4. Path Systems 5.Hydroelectric Facility

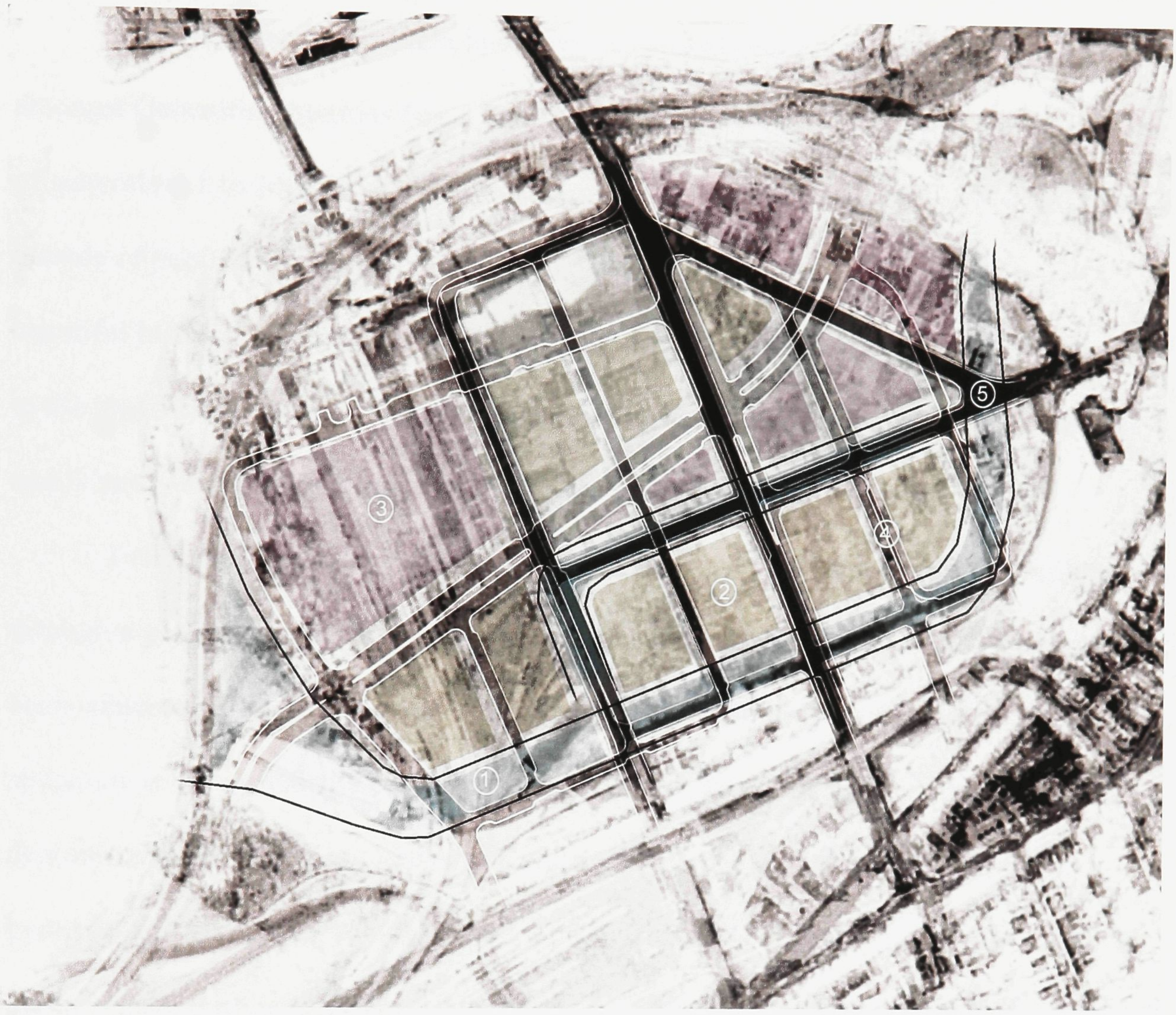


Fig. 29. *Palimpsest Map,* digital collage, 2005. Arial Photographs by National Resources Canada.

Site Limitations and Opportunities

Despite the Ottawa River which flows to the north of the site and the aqueduct running to its south, LeBreton Flats lacks the significant watercourse required for generating hydroelectric electricity. While there is a significant elevation change of 12m at the tailrace exiting the Pumping Station that would provide an appropriate head in any small-scale hydroelectric operation, without any water running over its crest, power cannot be generated. As a result, it must be questioned why a hydroelectric generating station is being positioned for LeBreton Flats.

While another small-scale hydroelectric generating station could be situated amongst Generating Stations No. 2 and 4, and there is consideration for a facility capable of generating 5 to 10 MW of electricity in that area, the station would nonetheless remain outside of public view and accessibility. [51] While both of the existing stations are beautiful historic structures perched delicately on the exposed bedrock they are unknown to the majority of Ottawa citizens. Situated within an area that is perceived as industrial and is rarely experienced, they remain beyond public attention and notice.

LeBreton Flats on the other hand is a public site. Though it is now controlled through a government agency it can still be visited at any time. Similarly, while it has been subjected to countless studies and development configurations in the political spectrum, it has provided a central setting to the city that is well suited to festivals and demonstrations, as well as recreational endeavors. In this capacity, the siting of the hydroelectric generating station and park on LeBreton Flats would immediately induce public debate (public referring to any Ottawa citizen that might view or visit the site) and sustain social interaction. Ultimately, it would draw attention to the sustainable landscape and the associated technological structures that support hydroelectric generation, and make the public visitor question its merit, its ecological consequences and hopefully reflect on the devastating effects that less sensitively considered technologies impart on the organic landscape.

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[51] Michale Wiggin, and Claude Faucher, personal interview, 15 October 2004.

Chapter 9: The Sustainable Landscape

In the essay *Infrastructure as Landscape*, Gary Strang questions why infrastructure systems have failed to have an effect on architectural and urban form. While these technological and organic systems support and structure our modern lives, they have little meaning in the places we live, work and play. As a landscape architect, Strang is familiar with interconnected systems. Working with the organic landscape he understands how environments can grow and die depending on proper temperature and available moisture. With architecture however, Strang sees a discipline at a loss with the systems operating around it. Technological infrastructures, such as the power line and generating station, are "cosmetically" mitigated and hidden so as to appear non-existent or less obtrusive. [52] As a result, the architectural form and technological process remains divorced from those who depend on it. Landscape architect and theorist Robert Thayer illustrates this separation when he states:

> Ask a few people in your community where their water or electricity comes from, or where their waste goes. Few will have any idea of the whereabouts of their sewage treatment plant, power plant, or which fuel resources provide their electrical power.[53]

With the design of the sustainable landscape I have countered this paradox by transforming the previously isolated hydroelectric facility into a public structure, and a confusing technological process into an urban event. Sited on LeBreton Flats in Ottawa it is additionally framed and supported by a park setting, which being in close proximity to

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[52] Gary Strang, "Infrastructure as Landscape," Theory in Landscape Architecture: A Reader, (Philadelphia: University of Pennsylvania Press, 2002) 221.

[53] Thayer 78.

the surrounding city, places the power system as an accessible and interactive infrastructure system. Since the hydroelectric station and the supporting park mark the natural force of the organic landscape with the generation of "green" electricity, I have invested the resulting architecture and landscape with a spatial and functional order derived from both a technological and organic infrastructure system.

Fig. 30. *The Sustainable Landscape,* digital collage, 2004. Created by author.

Objectives

The architectural/landscape design component of this thesis strives to educate the public about hydroelectric generating facilities and their ecological implications. By engaging with the technological structures that support the generation of hydroelectric power - explicit, implicit, invisible, energetic and sustainable - I believe that we can better understand *how* electricity is generated, and more importantly, *what* the impacts of power generation are on the organic landscape. This understanding would then allow a reflection on modernity's dependence on electricity. The intended result is a widespread conservation of energy and electricity via education, and the embrace of sustainable principles within modern society. Furthermore, working with the two sustainable hydroelectric facilities located and operating in the adjacent Chaudiere Falls area of the Ottawa River, the generating station helps provide the city of Ottawa with enough "green" electricity to cover the electrical needs of 15,960 private dwellings, or ten percent of the total number of households within the Ottawa city proper. These objectives are achieved through five sequential architectural/landscape design developments for the LeBreton Flats site that can be categorized as follows:

1. Canals

Three canals (a principal watercourse, tailrace and recreational/supply canal) are excavated on the site to transfer water from the Ottawa River, through the small-scale hydroelectric facility and into the Pumping Station's tailrace area. They are 4m, 15m and 1m in depth respectively and average 20m to 40m in width. While such excavation is a deliberate technological cut onto the physical fabric of LeBreton Flats, and a costly expenditure with limestone only metres from the surface, it is nonetheless seen for its sustainable potential in the generation of "green" electricity. The tailrace and recreational/supply canals further support recreational activities such as rowing and winter skating on the latter, and kayaking on the former.

2. Rock and Soil Beds

In the course of constructing the three canals 266,950m^3 of rock and soil are excavated. Thus, in order to embody sustainable principles, the excavated earth is re-appropriated within the site as rock and soil beds, and is re-used as base building material in the hydroelectric facility and park. In this capacity, the physicality and history of the site is not lost with the transfer of that material to a secondary location outside of the city proper. Contaminated material is isolated from the publicly accessible rock beds to prevent the contaminants from harming the park visitor or leaching into the watercourses.

3. Organic Areas

Organic areas are those places within the sustainable landscape that have not been modified or affected by the introduction of the sustainable technologies. While the majority of these areas have been left in their native state (long grasses) and are treated as organic repositories, certain locations have been programmed for public and recreational uses, such as a large public gathering and festival space, and an all-purpose field for sports such as soccer and football.

4. Path Systems

Two path systems cross the site and create places for public interaction, pedestrian movement and cycling within the park. Sited off the palimpsest map and significant viewpoints within the area, the paths provide access to the hydroelectric facility, canal segments, rock and soil beds, organic areas and ultimately, to the surrounding city, buildings and green spaces. They are additionally illuminated through a consistent lighting system that creates a safe environment for park users at night, while at the same time celebrating the result of the hydroelectric generating process.

5. Hydroelectric Facility

The small-scale hydroelectric power generating station is designed to allow the public visitor to actively engage with and understand the power generating process. Complementing this educational focus is the pragmatic concern of providing ten percent of Ottawa's 156,482 private dwellings with "green" electricity in conjunction with the two additional generating stations in the Ottawa River. The ten percent sustainable mandate is positioned as a way to ensure that the electrical output of the three stations is an important component in supplying Ottawa's electrical needs, rather than merely a token gesture aimed at promoting sustainable power generation.

Generating Potential of the Site

To ensure that the hydroelectric facility will generate enough "green" electricity to meet the ten percent sustainable mandate the following study was undertaken. Based upon the 2001 Canadian Census the tables show how much electrical power output can be generated from a hydroelectric facility on LeBreton Flats. The numbers relating to the head, design flow and number of turbines required in the hydroelectric facility form the technological parameters from which the architectural design of the hydroelectric facility is based.

Table 1: City of Ottawa Population Statistics

	1996 Population	2001 Population	Population Change	2005 Projected Population
Ottawa (City Proper)	323,340	337,031	4.2%	351,186

Table 2: City of Ottawa Dwelling Statistics

	2001	Population Change	2005 Projected
Number of Private Dwellings in Ottawa (City Proper)	150,175	4.2%	156,482

Table 3: Current Green Energy Generating Capacity

	Number of Turbines	Efficiency Range	Head (m)	Design Flow (m^3/s)	Electric Power Output (kW)
Generating Station No. 2	4	81%	12	21	7,920
Generating Station No. 4	2	81%	12	23	4,386

Table 4: Proposed Green Energy Generating Capacity

	Number of Turbines	Efficiency Range	Head (m)	Design Flow (m^3/s)	Electric Power Output (kW)
Small-Scale Hydroelectric Facility	5	81%	10	~ 22	8,745
Generating Station No. 2 & 4	6	81%	12	21/23	12,306
Total	11	-	-	-	21,051

Table 5: Percentage of Private Dwellings Supplied With Green Electricity

	Total Electric Power Output (kW)	Average Domestic Electrical Use Per Hour (kWh)	Total Number of Private Dwellings Supplied	Percentage of 2005 Projected Private Dwellings Supplied
Ottawa (Dissolved)	21,051	1.2	17,542	11 %

Initial Power Generation Studies

To locate and understand how hydroelectric power could be generated on LeBreton Flats I undertook a series of power generating studies that informed the extent to which the site would need to be developed in order to provide Ottawa with the ten percent sustainable mandate. Within each study, wind turbines and photovoltaic cells were also added, increasing the quantity of sustainable power generated on the site. Since they were undertaken at the time of initial design and prior to the creation of the palimpsest map, the configurations were located to engage areas with a high degree of vehicular and pedestrian activity, and to maximize the generating capacity of the site, rather than acting as a reflection of the site's history and memory as articulated by infrastructure systems.

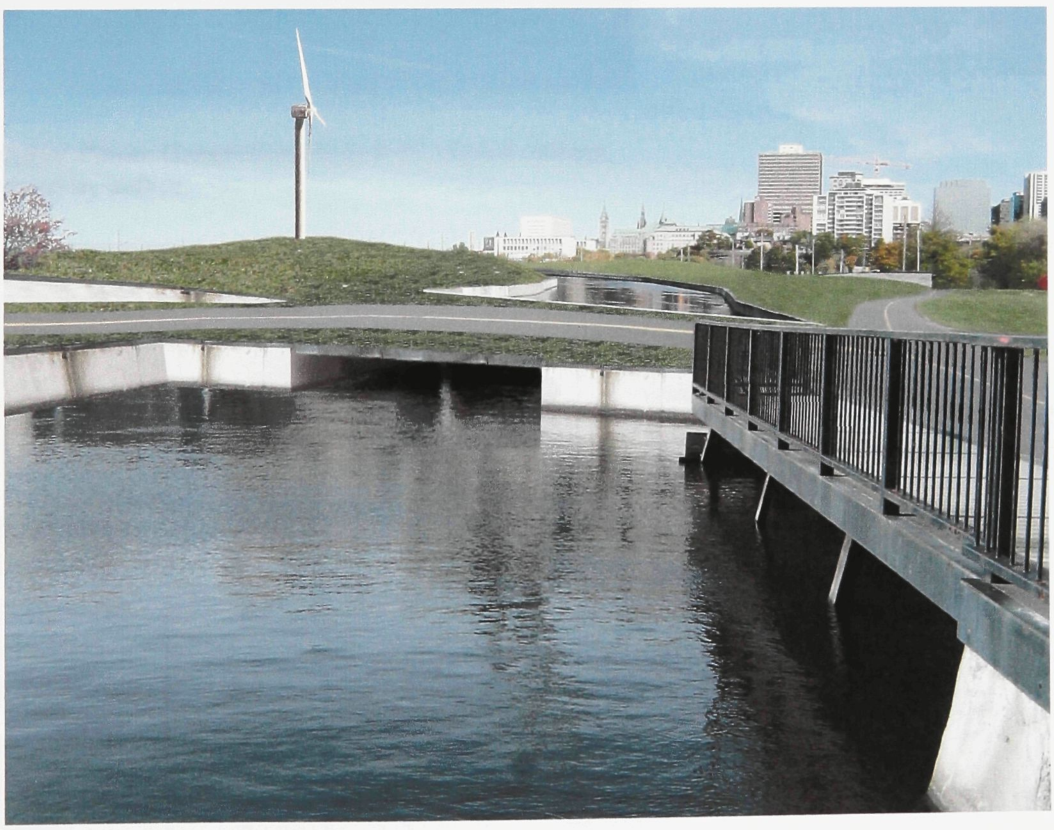

Fig. 31. *Reconfigured LeBreton Flats*, digital collage, 2004. Created by author.

Initial Power Generation Study #01

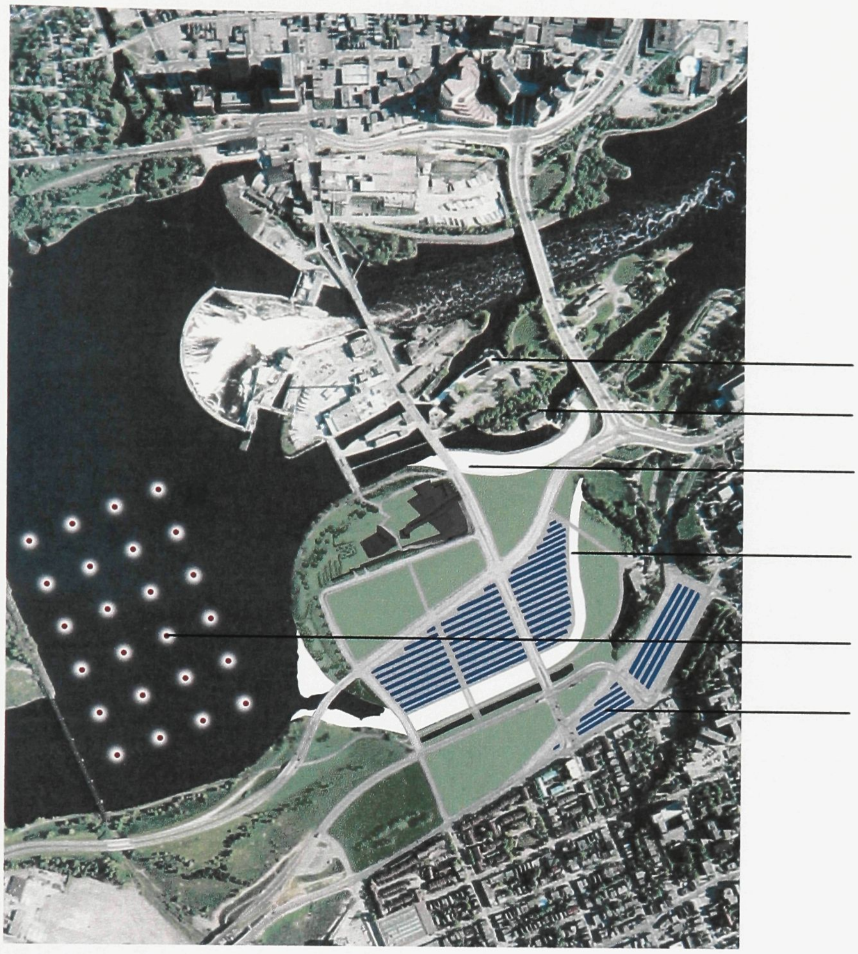

Fig. 32. *Initial Power Generation Study # 01*, digital collage, 2004. Created by author.

Table 6: Initial Power Generating Study #01 Generating Capacity

	Quantity	Area (m^2)	Electric Power Output (kW)	Percentage of Ottawa's Private Dwellings Supplied
Hydroelectric (Proposed)	2	-	16,790	8.9%
Hydroelectric (Existing)	2	-	12,306	6.6%
Wind Turbines	24	-	2,400	1.3%
Photovoltaic Cells	-	30,000	3,000	1.6%
Total	-	-	34,496	18.4%

Initial Power Generation Study #02

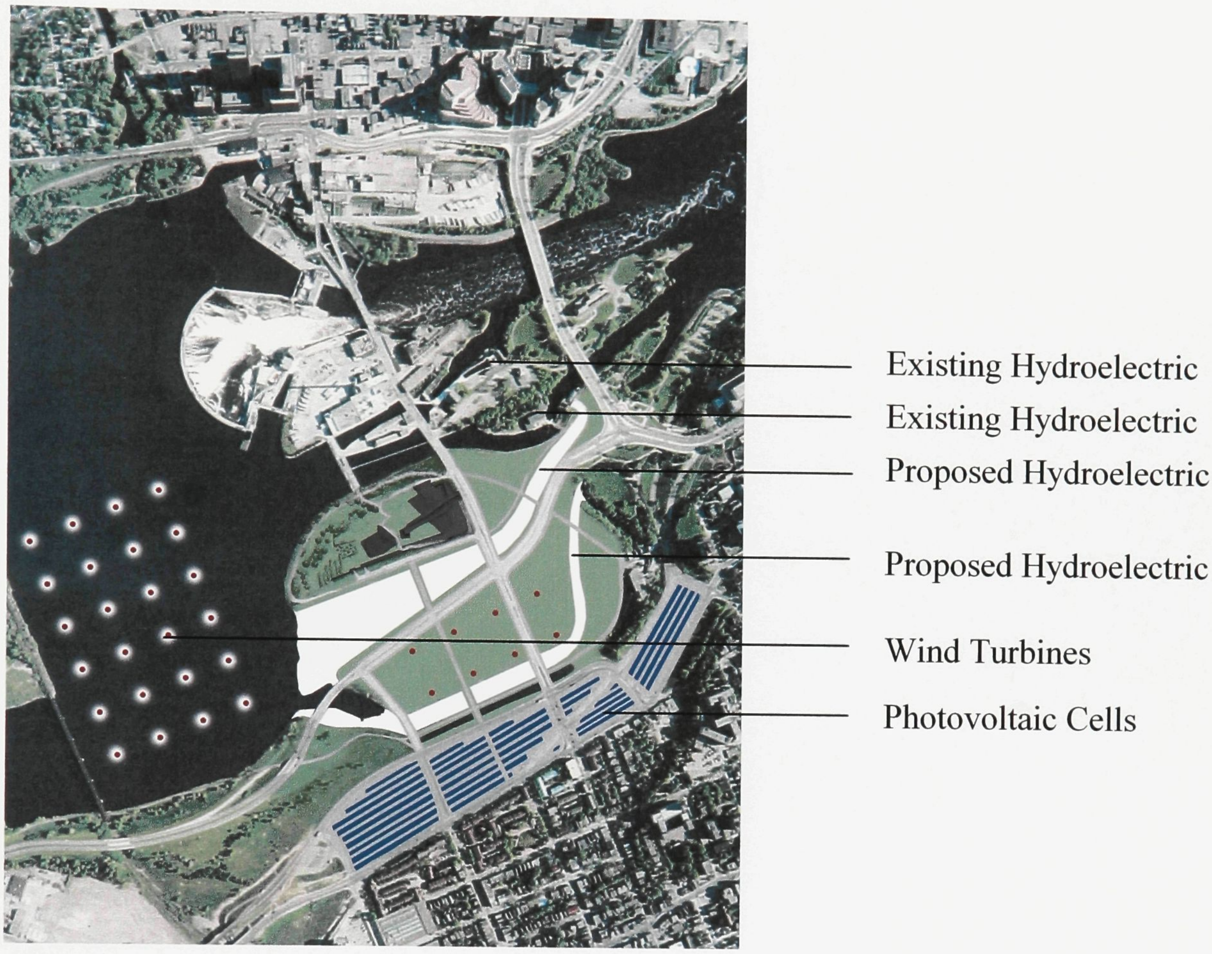

Fig. 33. *Initial Power Generation Study # 02*, digital collage, 2004. Created by author.

Table 7: Initial Power Generating Study #02 Generating Capacity

	Quantity	Area (m^2)	Electric Power Output (kW)	Percentage of Ottawa's Private Dwellings Supplied
Hydroelectric (Proposed)	2	-	16,790	8.9%
Hydroelectric (Existing)	2	-	12,306	6.6%
Wind Turbines	32	-	3,200	1.7%
Photovoltaic Cells	-	25,000	2,500	1.3%
Total	-	-	34,796	18.5%

Initial Power Generation Study #03

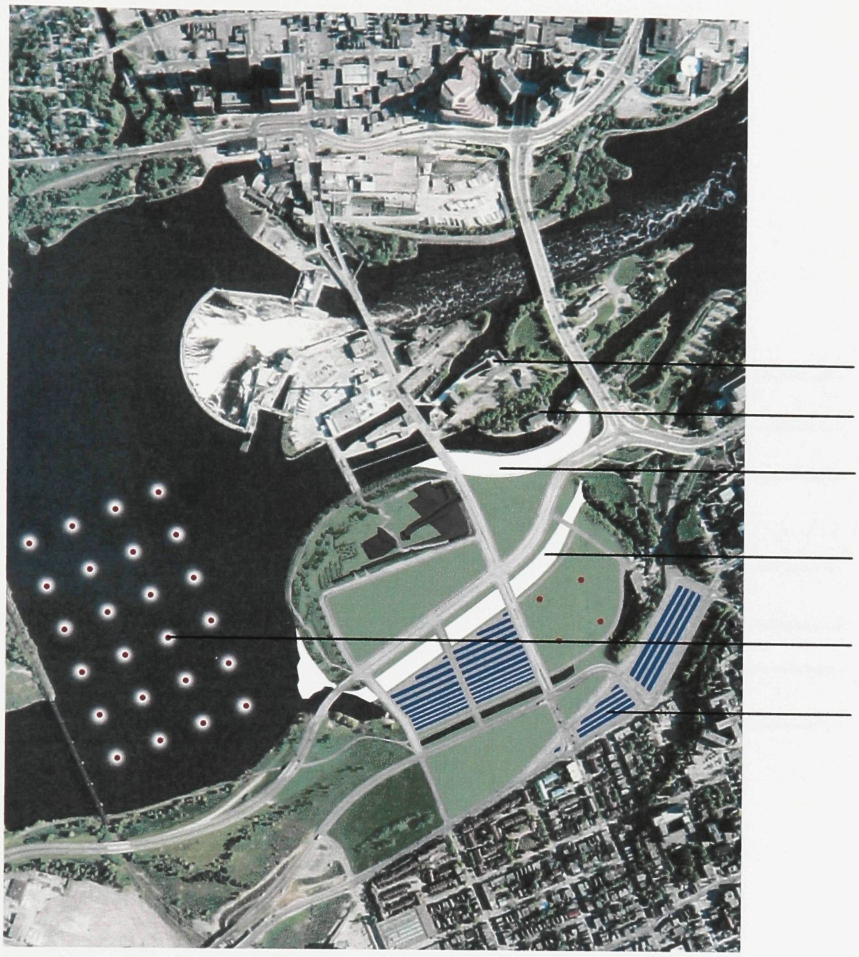

Fig. 34. *Initial Power Generation Study # 03*, digital collage, 2004. Created by author.

Table 8: Initial Power Generating Study #03 Generating Capacity

	Quantity	Area (m^2)	Electric Power Output (kW)	Percentage of Ottawa's Private Dwellings Supplied
Hydroelectric (Proposed)	2	-	16,790	8.9%
Hydroelectric (Existing)	2	-	12,306	6.6%
Wind Turbines	28	-	2,800	1.5%
Photovoltaic Cells	-	25,000	2,500	1.3%
Total	-	-	34,396	18.3%

Initial Power Generation Study #04

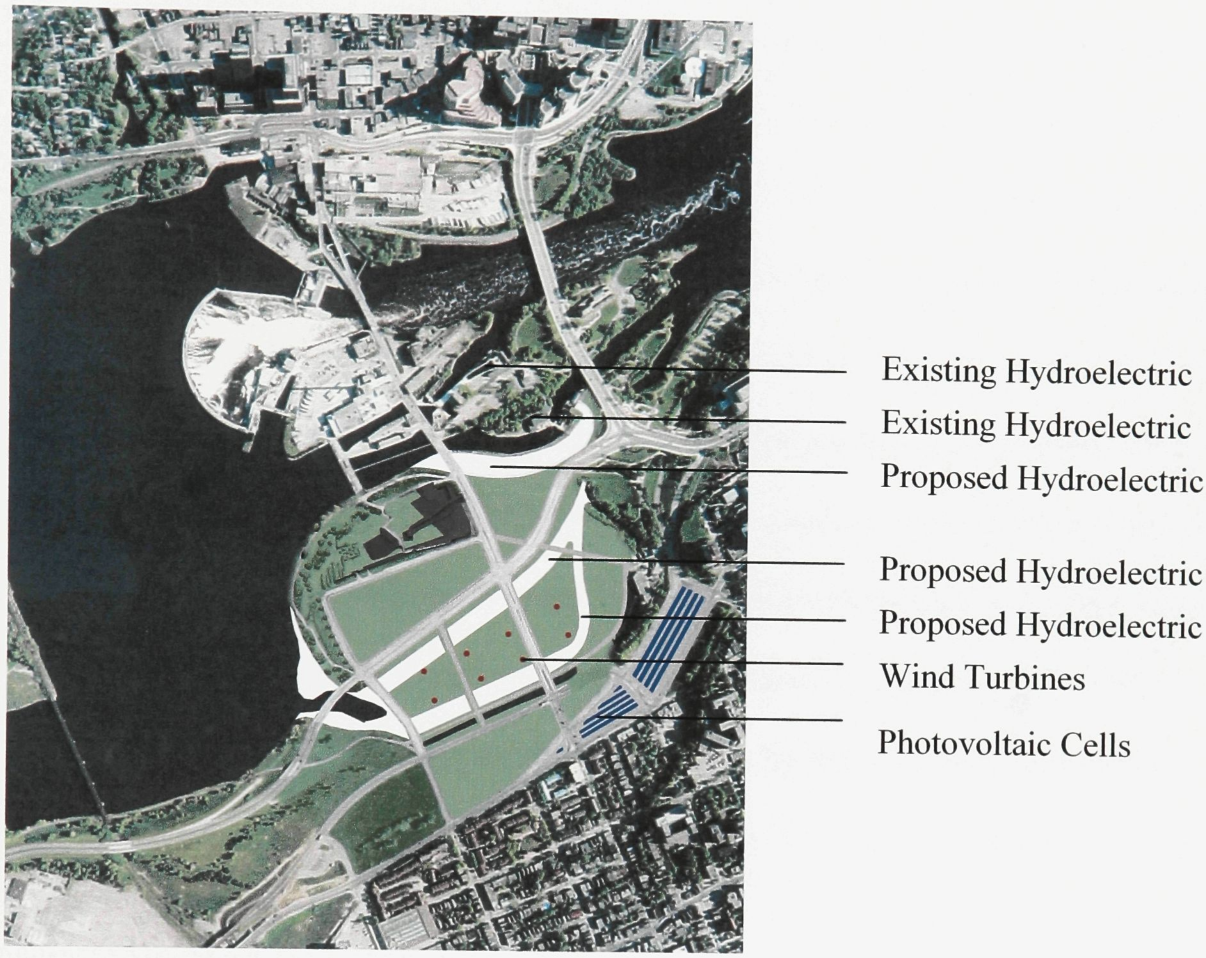

Fig. 35. *Initial Power Generation Study # 04*, digital collage, 2004. Created by author.

Table 9: Initial Power Generating Study #04 Generating Capacity

	Quantity	Area (m^2)	Electric Power Output (kW)	Percentage of Ottawa's Private Dwellings Supplied
Hydroelectric (Proposed)	3	-	25,185	13.4%
Hydroelectric (Existing)	2	-	12,306	6.6%
Wind Turbines	8	-	800	0.4%
Photovoltaic Cells	-	10,000	1,000	0. 5%
Total	-	-	39,291	20.9%

Initial Power Generation Study Analysis

While none of the initial schematic studies became the final siting strategy for the sustainable landscape, they were an effective way by which to understand and assess the generating potential of the site. Even though wind turbines and photovoltaic cells would have been significant elements in the sustainable landscape, their use was unsustainable in relation to the physical nature of the site; the wind in the area is not strong enough or consistent in its direction to support large turbines, and the use of photovoltaic cells requires a larger land area and consistent sunlight to generate a reasonable amount of electricity. As a result, both the wind turbines and photovoltaic cells were later eliminated from the design scheme. Similarly, the creation of a series of canals and a varying number of hydroelectric stations was reduced to one facility and three canals (the principal watercourse, tailrace and a recreational/supply canal). This ensured that less water was diverted from the Ottawa River, and thus, did not compromise the water flow of the Ottawa River, fish habitat or the generating capacity of Generating Stations No. 2 and 4.

Canals: Precedent

While the excavation of the three canals is a technologically intrusive act against the organic landscape, its construction must be assessed in regard to the sustainable and educational benefits it provides to the city of Ottawa in the form of "green" electricity, and to the public visitor enjoying the park. To offer a precedent on the construction of a canal within an urban area for the purpose of hydroelectric power generation we might briefly consider the Ontario Power Generation's recent construction of a 10.4km long tunnel under the city of Niagara Falls. The Niagara Tunnel Project aims to divert $500m^3$ of water from the Niagara River to the Sir Adam Beck hydroelectric complex. This will increase the total electrical output of the complex by 14%, which translates to 1,600 GWh of electricity generated per year or enough renewable electricity to meet the needs of a city twice the size of Niagara Falls (78,815).

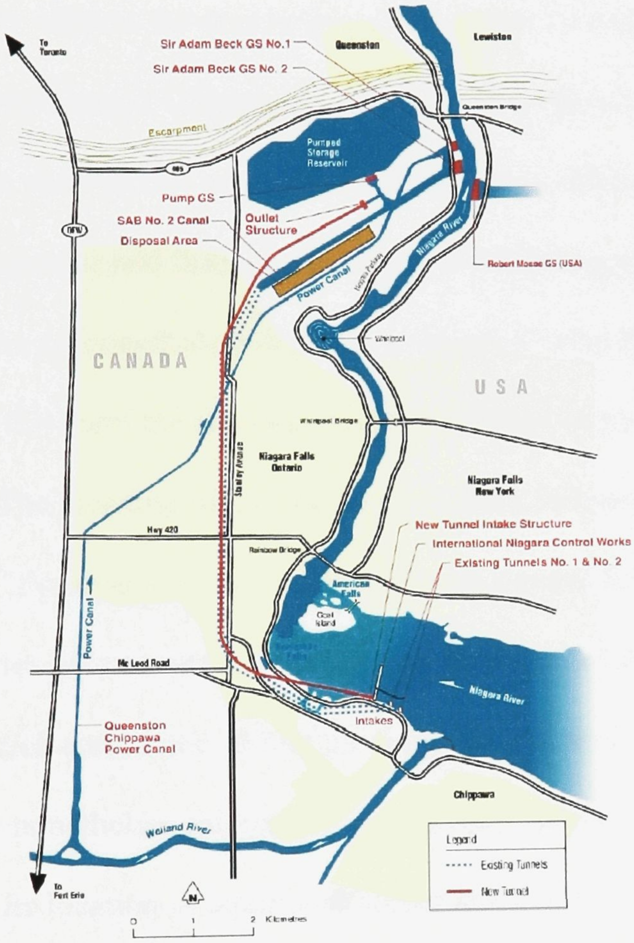

Fig. 36. *Niagara Tunnel Project*, Niagara Falls, Canada, 2005. Map by Ontario Power Generation.

Sited parallel to two existing tunnels and canals that already transfer water to the hydroelectric complex, the project is being heralded by the Ontario Power Generation as "being consistent with its objective of promoting the development of cost competitive, environmentally friendly sources of electricity." [54] While this project will be extremely labour intensive and will undoubtedly incur cost overruns during construction, it nonetheless ensures that electricity generated through renewable means is an integral part of the province of Ontario's electrical supply.

Canals: Conceptual Development

To conceptually address the excavation of the canals I would like to briefly discuss the work of artist Dennis Oppenheim. Creating artworks situated in the organic landscape, Oppenheim showed that art could be structured to reflect systems and relationships between people and their environment. While being an abstraction of the actual relationships, the art nonetheless drew associations to what he would term a "line of information." [55] In this form the artwork would "reference larger fields of association beyond the art itself. The meaning of the site was, in effect, transposed from one semantic context to another." [56] For example, in his 1968 artwork *Annual Rings* Oppenheim intentionally cut a series of concentric rings into the winter ice of the St. John River between New Brunswick and Maine. While the rings did not connect from one side of the river to the other they nonetheless referenced systems beyond the physical nature of the river and ice, such as its location as a political border and a division between time zones.

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[54] Ontario Power Generation, Niagara Tunnel Project, 02 September 2005 <http://www.opg.com/ops/niagaratunnel.asp>.

[55] James Dickinson, "Journey Into Space: Interpretations of Landscape in Contemporary Art," Technologies of Landscape: From Reaping to Recycling, ed. David. E. Nye, (Amherst: University of Massachusetts Press, 1999) 45.

[56] Dickinson 45.

Similarly, since the rings were concentric he also referenced the growth rings of a tree and thereby called attention to the biological capacity of the river. [57]

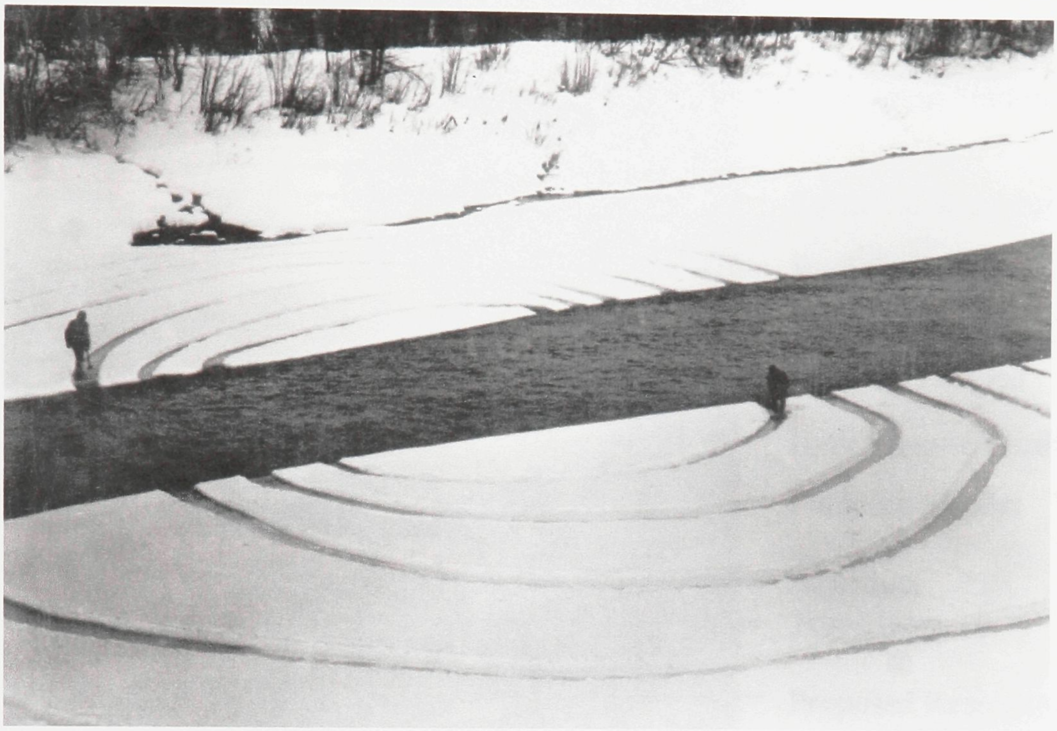

Fig. 37. *Annual Rings*, U.S.A./Canada Boundary at Fort Kent, Maine, and Clair, New Brunswick, 1968. Photograph by Dennis Oppenheim.

Apart from providing the water to drive the turbines of the hydroelectric generating station, and to a lesser extent, supporting recreational activities, the excavation of earth and the creation of canals across LeBreton Flats also references systems existing outside of its functional roles. Similar to the referential fields created by the earthworks of Oppenheim, the canals conceptually reference the industrial history of the site through its technological formation, the importance of canal construction in Ottawa's cultural history as manifested by the Rideau Canal, and ultimately our contemporary technological control over organic nature. This is accomplished by the juxtaposition of the organic forms of the site with that of its architecturally formed edges.

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[57] Dickinson 45.

Rock and Soil Beds

To further connect the sustainable landscape to the history and memory of LeBreton Flats, the excavated rock and soil resulting from the construction of the canals is re-appropriated within the site in zones prescribed by the palimpsest map. In this capacity the layers of retained earth act as organic, infrastructural and cultural markers within the sustainable landscape. Since the soil is contaminated with oils and chemicals from the former industries and rail yards, it is separated from the rock beds to ensure that the park setting is a safe place for the public visitor. Contained within wood and concrete enclosures that stand over 2m in height, the retained soil (predominately a sandy clay with varying quantities of building rubble, ash, coal slag and charred wood) exists outside of public reach while it is subsequently bio-remediated through solvent-eating bacteria.

Fig. 39. *Rock and Soil Beds*, collage, 2004. Created by author.

Alternatively, the excavated rock, which is predominately limestone and free of contaminants, is placed and contained on the site with a relative level of transparency and accessibility. This is achieved by containing the rock beds within areas of chain fencing, low concrete walls, and in some instances, the complete removal of any architectural edge. In this form the public visitor can climb both the limestone and the architectural walls, while the architectural edges allow water that might collect within the rocks to flow back towards the Ottawa River where it can be used in the hydroelectric generating process.

Organic Areas

The organic areas of the sustainable landscape contrast the technologically formed canals, rock and soil beds, path systems and hydroelectric facility with the acceptance of the site's natural forms and vegetation. Left covered in the existing grass, the areas mediate on the sustainable technologies by offering a landscape that acts to sustain the organic nature of the site. In addition to reflecting how the site existed following the 1962 expropriation, the relatively consistent and expansive terrain also support recreational activities such as soccer and cycling. Similarly, they provide space for large public gatherings and festivals such as in the area directly across from the Canadian War Museum that backs onto the watercourse supplying Generating Station No. 2. As a triangular site with a significant change in elevation across its breadth, the area is especially well suited to musical performances in that it can contain a large audience while providing unobstructed views towards a permanent stage located at the intersection of Booth and Wellington Streets.

Organic Areas: Location

Fig. 40. *Organic Areas: Location*, basswood and cardstock model @ 1:1000, 2005. Created by author.

Table 11: Organic Areas (Programmatic Components)

	Location	Additional Park Programs
Organic Repository	1	Cross country skiing in the winter
Festival Space	2	Festival and performance space
All-Purpose Field	3	Area for large public gatherings and field sports
Power Corridor	4	Electrical transmission and cycling

Path Systems

As infrastructure elements, the path systems offer connections to both the technological and organic components of the sustainable landscape, as well as to the surrounding city, buildings and green spaces. The primary objective is to move the public visitor across the park setting, and to orientate those individuals towards the different components of the hydroelectric process. One path system follows the contours of the site and is based from the layers of infrastructure of the palimpsest map, while a second, higher path system moves between the rock beds and is corresponds to significant viewpoints in the area.

To offer places of reprieve and to sustain social interaction within the park setting, the lower path system is additionally widened and invested with supporting programs. For example, at locations bordering the edge of the Canadian War Museum, the path is substantially increased in width to create a promenade that facilitates interaction and display for the Canadian War Museum. Similarly, along the edges of the canals wood benches and tables are added to create places for discussion and gaming.

The second, higher path system is sited to orientate the public visitor towards examples of the organic, technological and sustainable within the immediate and surrounding areas. This is achieved by using the rock beds and their respective architectural edges to frame desired views. This path is made accessible by ramps and stairs leading up from the lower path system, while linking the individual rock beds through a series of pedestrian bridges, enables the public to physically interact with excavated rock.

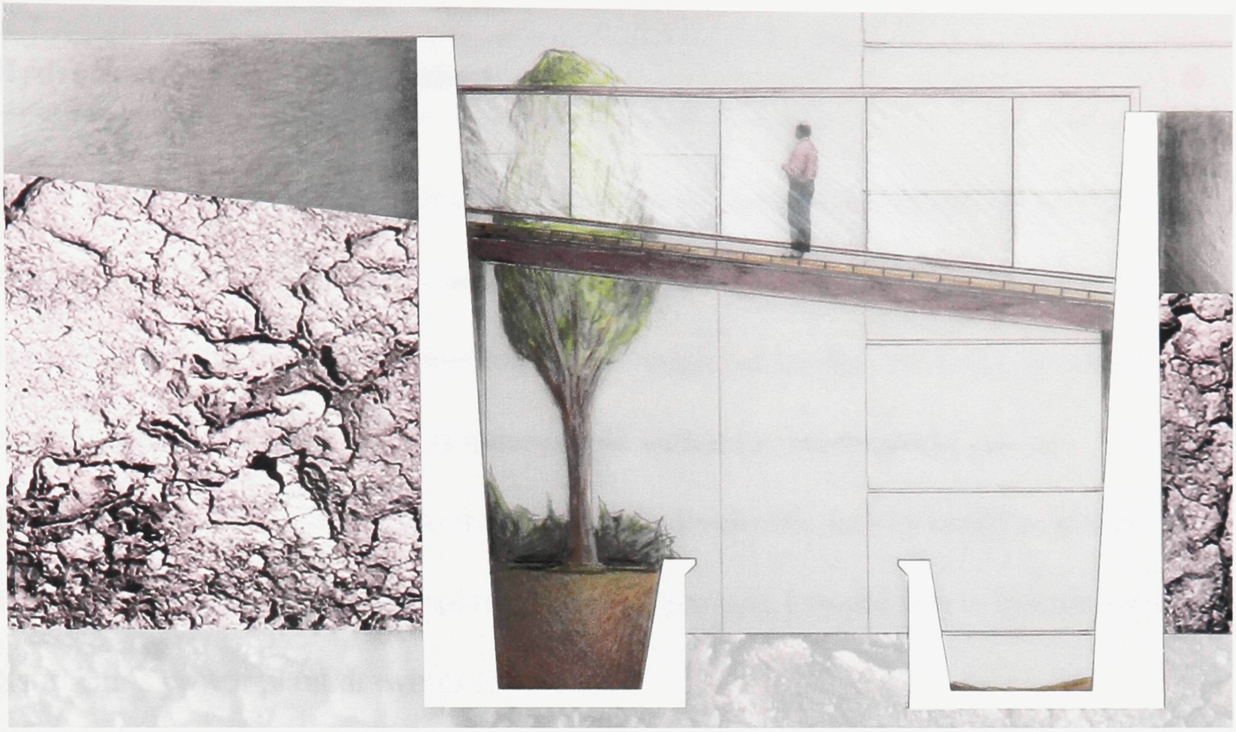

Fig. 41. *Path Systems,* collage, 2004. Created by author.

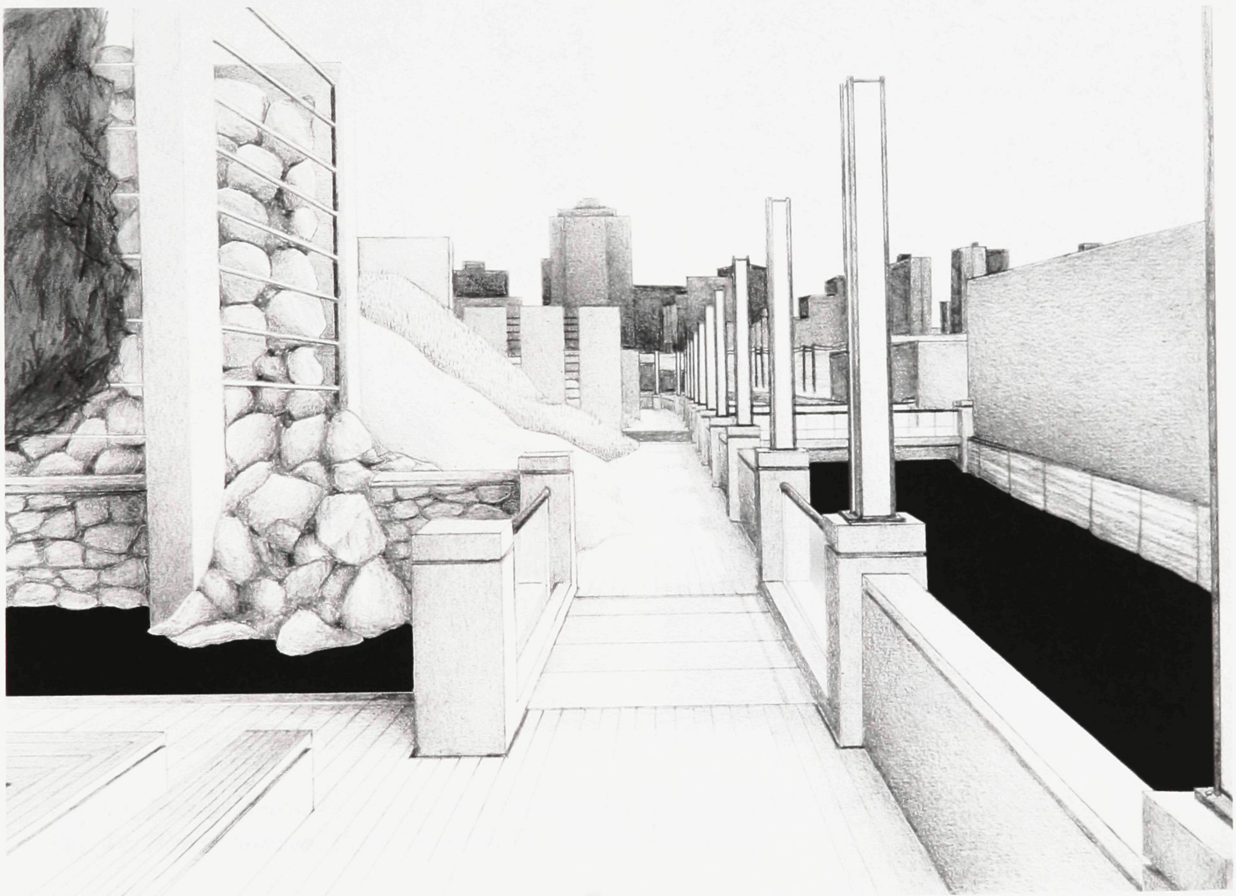

Fig. 42. *Park Perspective,* graphite rendering, 2005. Created by author.

Hydroelectric Facility: Precedent

Not only are hydroelectric facilities typically removed from the urban realms they support but they are also for the most part designed by engineers. Places such as the Hoover Dam allow public visitors to move through the facility, yet being situated in the desert outside of Las Vegas, it is inaccessible without some means of private transportation. Thus, in order to frame how a hydroelectric facility could be situated within an urban setting and support a public dimension, I would like to discuss Antonio Sant'Elia's power plant drawings from 1913.

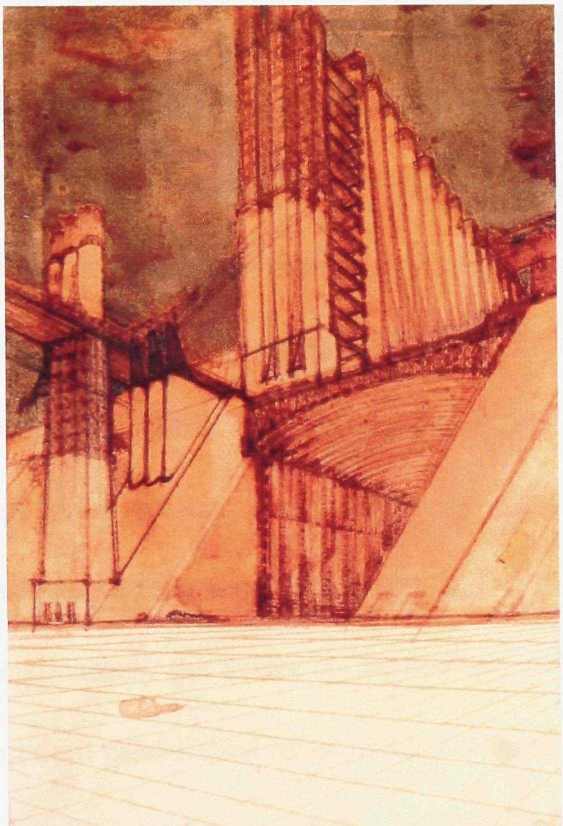

Fig. 43. *Hydroelectric Power Station*, 1914. Drawing by Antonio Sant'Elia.
Fig. 44. *Power Station*, 1914. Drawing by Antonio Sant'Elia.

As a member of the Italian Futurists, a group of artists, architects and writers who collaborated in Italy at the turn of the twentieth century and celebrated mechanical and industrial processes, Sant'Elia saw the power plant as an icon of modernity. As Luciano Caramel and Alberto Longatti, authors of *Antonio Sant'Elia: The Complete Works* from 1987, articulate on the drawings of the power plant series:

> The power plant is the fulcrum of urban renewal, the engine of the machine city, which the *Manifesto of Futurist Architecture* defines as being similar to an immense, tumultuous worksite. The power plant emanates the energy that produces movement and light, and is surrounded by large scale public installations and residential buildings. Without the power plant, the prime mover, everything would be at a standstill, and the city itself could not exist.[58]

In this regard Sant'Elia portrayed the power structure as a monumental form within the urban landscape. Captured through a bird's eye perspective the power plant is made to appear tall and intimidating, yet the focus of the city. This is further articulated through the numerous wires and infrastructure systems leaving the power plant, which can be seen to physically connect the building to the urban realm.

While there are no individuals visible in any of the drawings (this was a deliberate strategy to pronounce the importance of technology and its architectural form), the inclusion of plaza space at the front of the technological structures references the potential for public engagement. Similarly, although none of the buildings in the power plant series, which predominately depicted hydroelectric generating stations, were ever constructed, they nonetheless parallel some of the design objectives articulated in this thesis, namely the desire to site the hydroelectric facility as urban element. Following the precedent established by Sant'Elia's drawings I have in turn designed the hydroelectric facility to accept and sustain a public audience within the confines of the power generating process. Principally, the small-scale hydroelectric facility is designed to act as

[58] Luciano Caramel, and Alberto Longatti, Antonio Sant'Elia: The Complete Works, (New York: Rizzoli International Publications, Inc., 1987) 23.

an extension of the park (specifically the canals and path systems) and to help the public visitor access and understand the generating technologies.

Hydroelectric Facility: Programmatic Components

Programmatically, the hydroelectric facility is organized into two parts: technological space supported by the generating technologies, and social space supported by a public library. As a supporting element to the hydroelectric facility, the library volume acts to sustain social interaction within the building, and provides a place of reprieve within the sustainable landscape. The programmatic spaces for each of these architectural volumes and their respective areas are identified in the following tables.

Table 12: Technological Space (Programmatic Components)

	Area (m^2)	Notes
Powerhouse	374.0	Accommodates five turbines/generators and an overhead crane used for equipment repair.
Repair Bay	120.8	Dedicated support space for equipment repair with tool storage and working surfaces.
Penstock Chamber	626.1	An open space that provides access to the penstocks, turbine shaft and draft tubes.
Control Room	124.7	Location where electrical output is monitored and the generating technologies are operated.
Staff Offices	191.2	A series of rooms and meeting spaces for the electrical company in charge of the facility.
Staff/Public Washrooms	124.7	Facilities for both the visitor and those working in the building with adjoining change rooms.
Reception/Lobby	81.6	Secondary entrance to the building for workers and the electrical company.
Observation Deck	239.6	Outdoor viewing deck with cantilevered platforms.
Circulation	282.9	
Total Area (Perimeter)	1,050.0	

Table 13: Social Space (Programmatic Components)

	Area (m^2)	Notes
Public Library	237.6	Reading and discussion space with book stacks and computer terminals.
Sorting/Repair	33.0	Dedicated support space for book collection and repair.
Staff Offices	21.4	Two small offices for individuals working inside the library.
Staff/Public Washrooms	22.6	Facilities accessible for the public visiting the library and hydroelectric generating station.
Reception/Lobby	75.8	Principal public entrance and library information, book checkout and return.
Park Washrooms	48.5	Facilities accessible for the public visiting the sustainable landscape.
Circulation	217.5	
Total Area (Perimeter)	645.7	

Hydroelectric Facility: Formal Arrangement

Formally, the hydroelectric facility is divided into two volumes, which are separated by the spillway of the barrage dam and connected by a pedestrian bridge across this 12m gap. The volumes are structured on the same parti but are nonetheless different in height and length. The volume containing the social spaces is shorter in length and lower in profile, while the technological space is contained within a much taller and longer structure. In the case of the social space, the lower height reflects the profile of the site and reinforces the architectural space as a component of the sustainable landscape. Alternatively, in the technological space heights are increased as a response to the functional needs of the generating technologies, while at the same time increasing their visual and experiential weight.

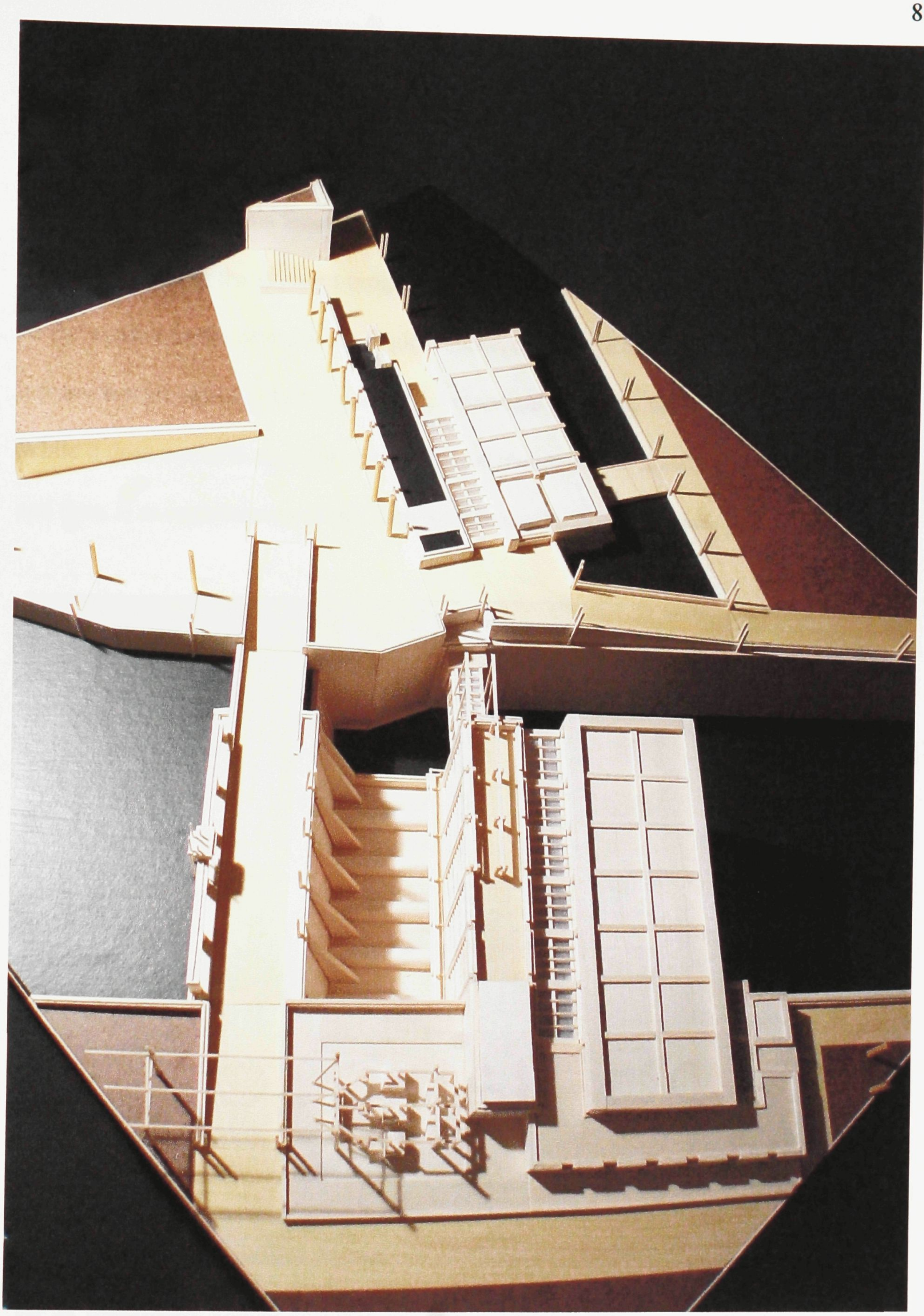

Fig. 45. *Hydroelectric Facility*: *Formal Arrangement,* basswood model, 2005. Created by author.

The two volumes are further broken down into three main components for each section. Within each architectural space a continuous skylight acts as a wedge between the larger programmatic volumes and a parallel circulation spine. In both the social and technological spaces this fenestration provides natural daylight into the structure, while visually separating the adjacent programmatic elements from a dedicated circulation path. At the eastern extent of the technological space, the wedge breaks past the volume where it forms a semi-public office space for the electrical company in charge of the facility. While it does not have skylights it nonetheless maintains the dimensions of the wedge and thus, is as an extension of that form past the technological space.

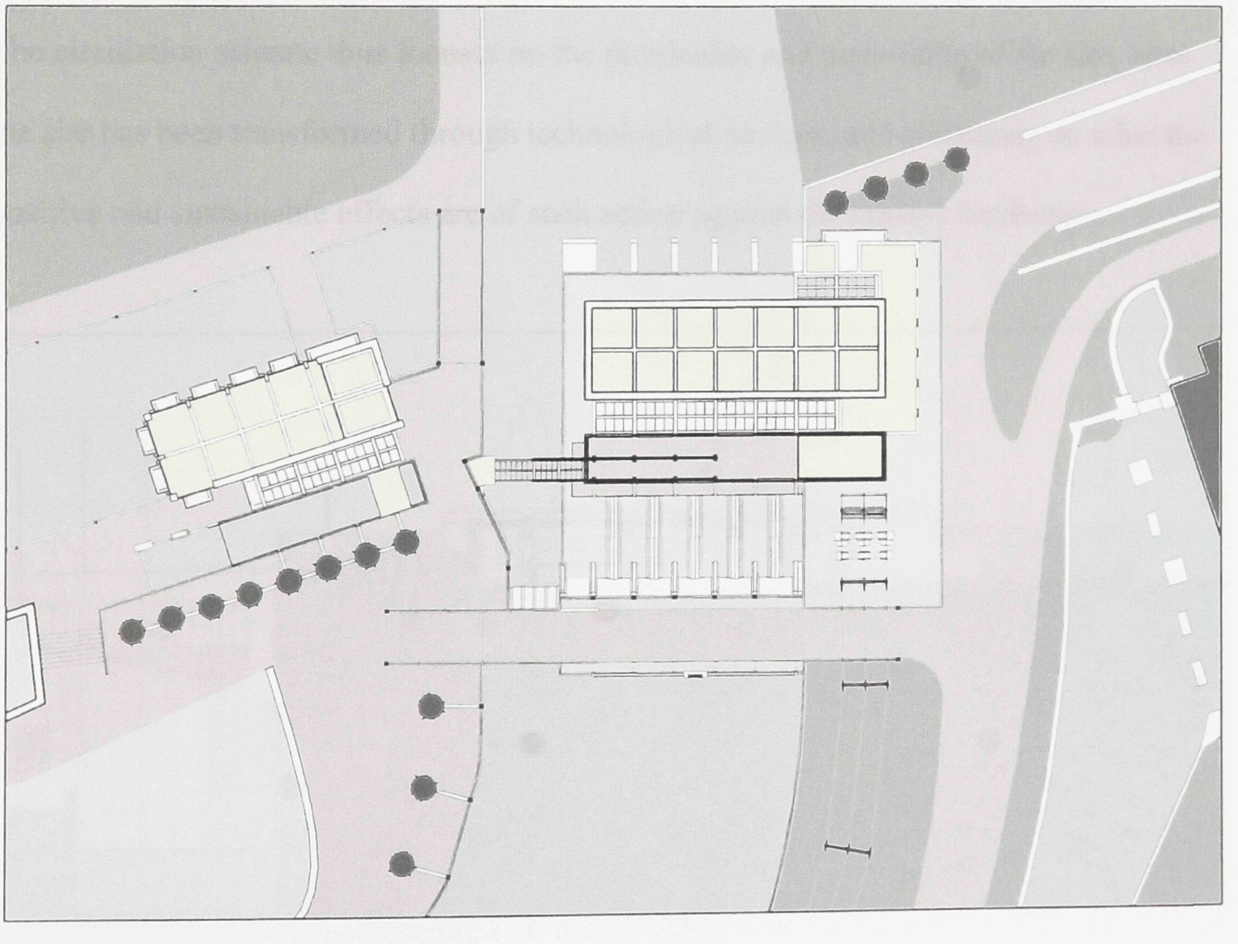

Fig. 46. *Hydroelectric Facility*: *Roof Plan,* AutoCad drawing @ 1:1000, 2005. Created by author.

Hydroelectric Facility: Circulation Scheme

The circulation scheme for the hydroelectric facility and the adjoining social spaces is an extension of the path system developed for the sustainable landscape. This is reinforced through the siting and access to the building, and the use of similar hard paving materials to delineate its course. The path is extended into the building where it connects the separate volumes and provides a narrative on hydroelectric power generation and its relationship to the organic landscape to the public visitor. This is achieved by moving the visitor in the park setting through the social space of the building, across the spillway, and down into the powerhouse of the technological space. The circulation scheme thus focuses on the physicality and materiality of the site, how the site has been transformed through technological devices, and ultimately on what the positive and sustainable effects are of such action against the organic landscape.

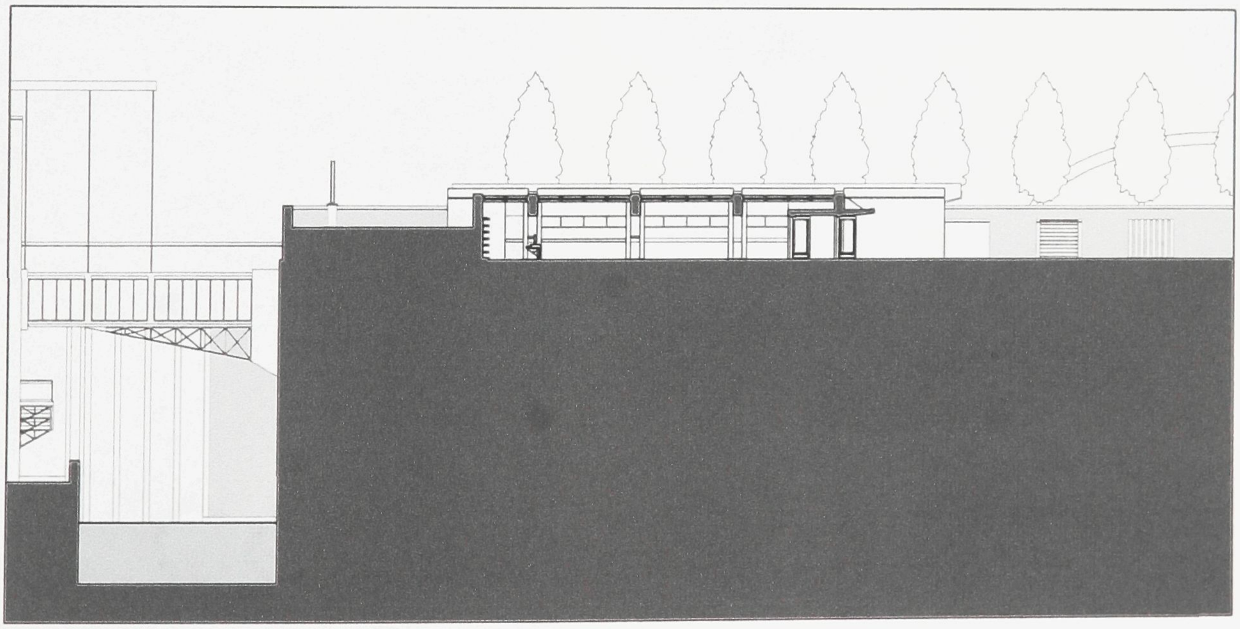

Fig. 47. *Hydroelectric Facility: Longitudinal Section*, AutoCad drawing @1:400, 2005. Created by author.

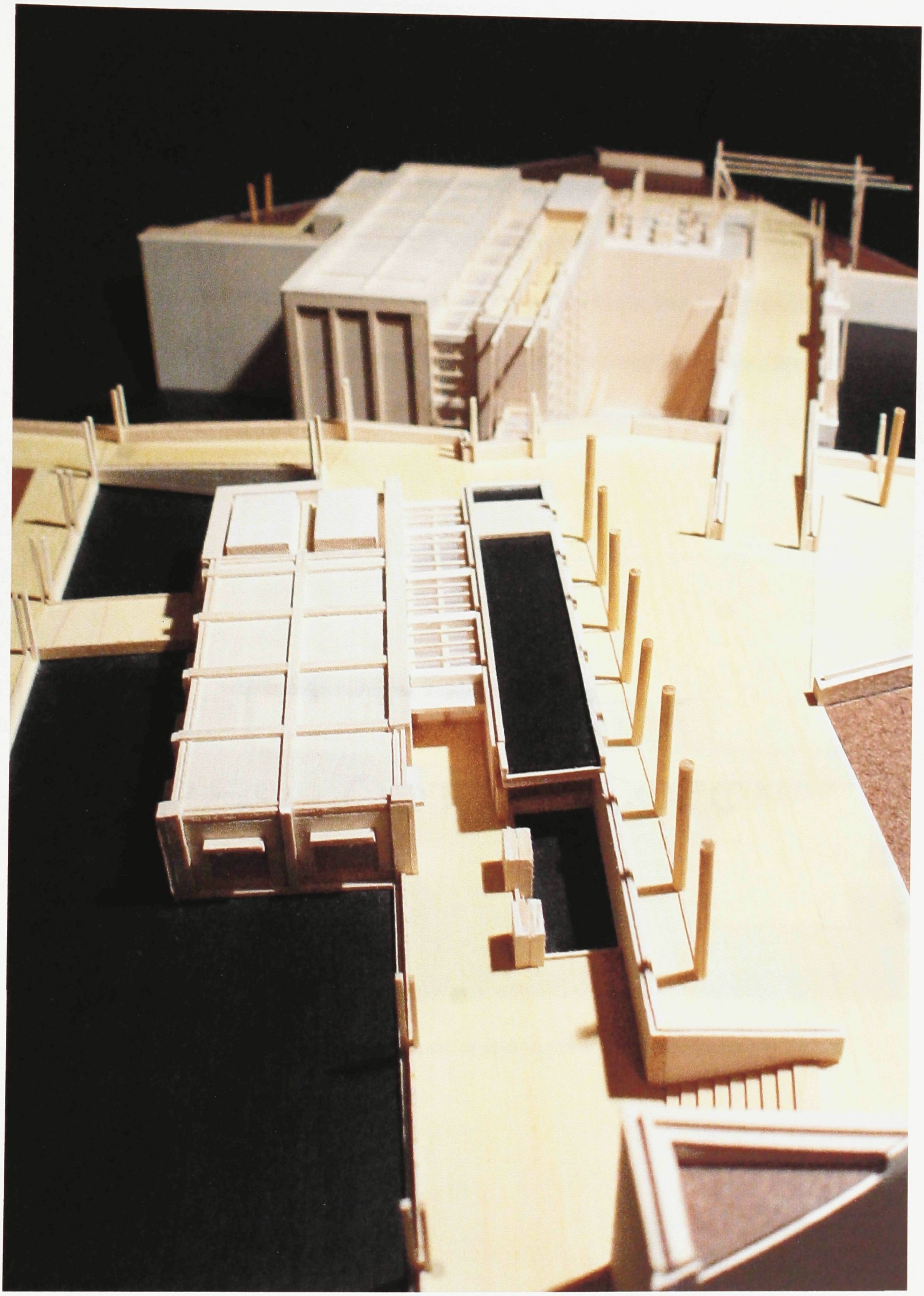

Fig. 48. *Hydroelectric Facility: Circulation Scheme,* basswood model, 2005. Created by author.

Hydroelectric Facility: Circulation Narrative

Entering the building at the wedge of the social space the public is moved past the library and into a dedicated circulation spine. Open to the entrance lobby on its right, it is framed by limestone walls and a concrete structural system on its left. This space brings the public visitor to the technological space of the powerhouse but first immerses the individual within the earth via a 3.5m ramped descent. Surrounded by the limestone and with limited lighting the public is made to feel a part of the site and thus, a part of the organic landscape.

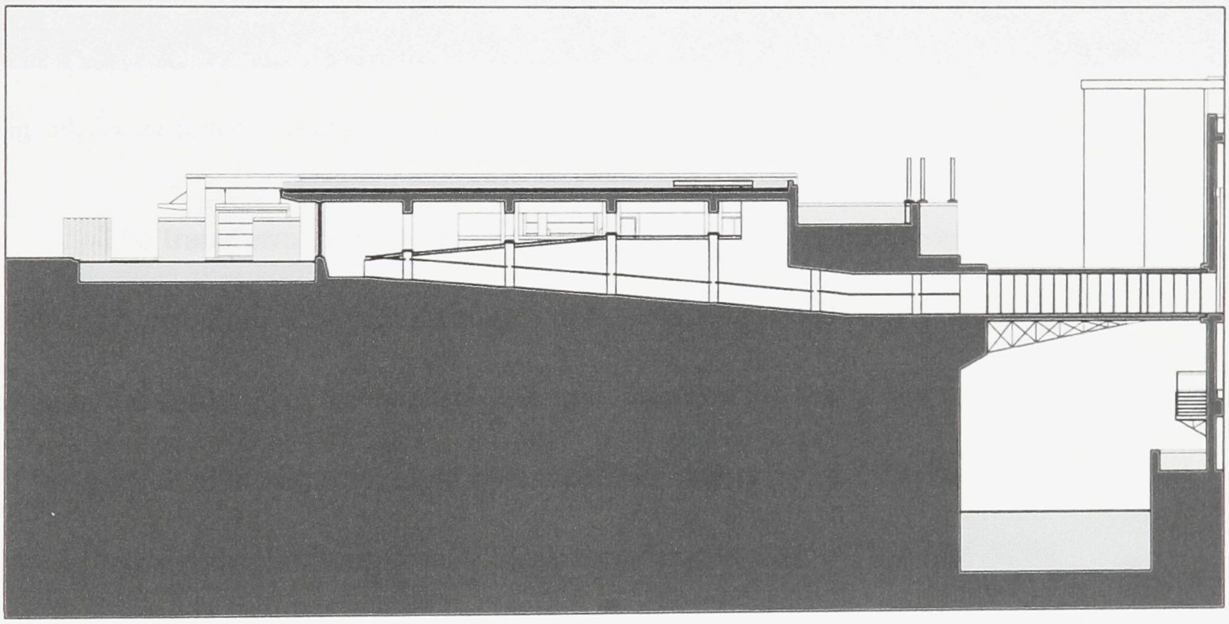

Fig. 49. *Social Space: Longitudinal Section,* AutoCad drawing @ 1:400, 2005. Created by author.

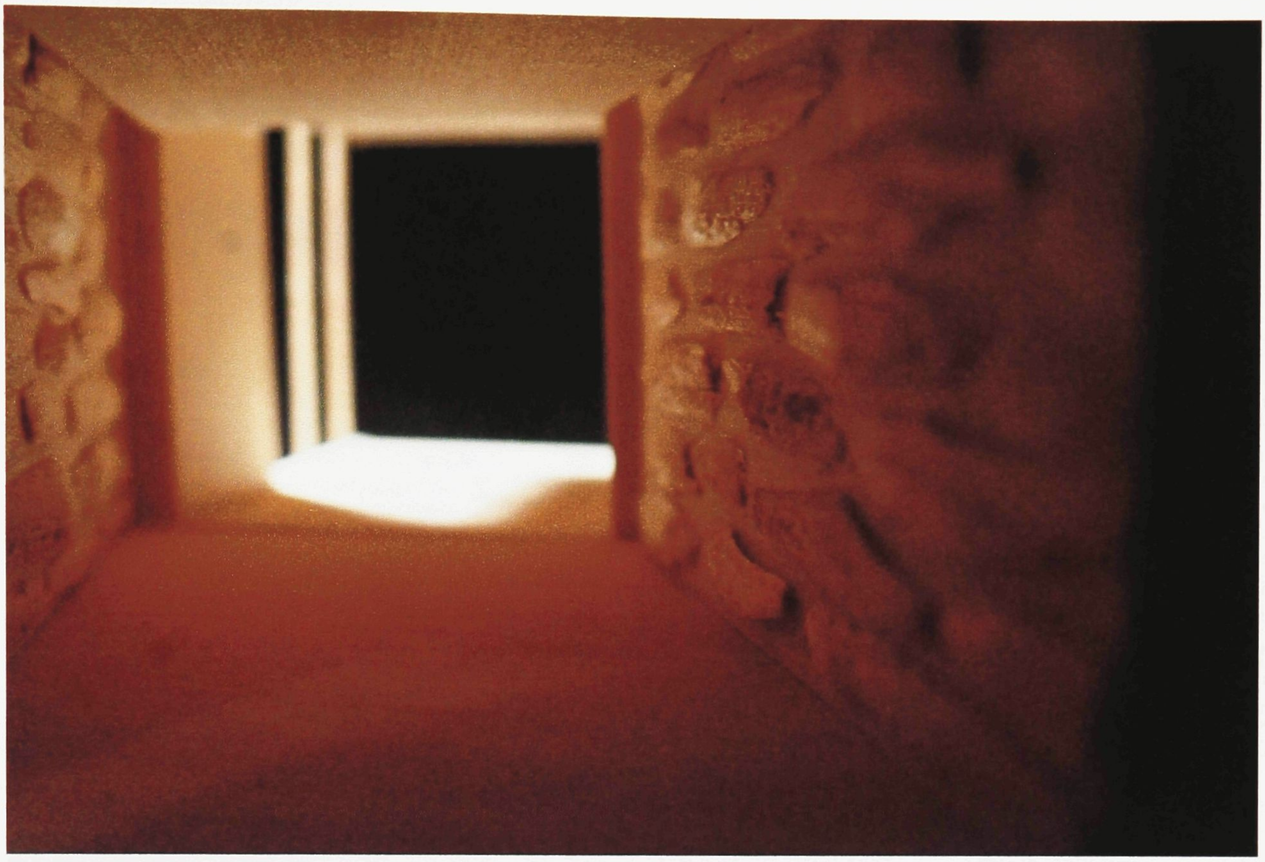

Fig. 50. *Social Space: Circulation Spine,* basswood model, 2005. Created by author.

The transformation of the site through technological means is articulated in the building's circulation system through a delicately suspended pedestrian bridge that crosses the spillway of the barrage dam and connects the social and technological spaces of the hydroelectric facility. Held by a steel truss system that is connected to the social space on one side and hung from a cable system supported off the roof of the technological space on the other, it immerses the public visitor within the scope of the excavation. Similarly, it positions the public in a situation where they can assess the majority of technological structures operating within the immediate area (the penstocks, spillway and barrage dam) and a portion of the technological transformations induced on the site (the principal watercourse and tailrace).

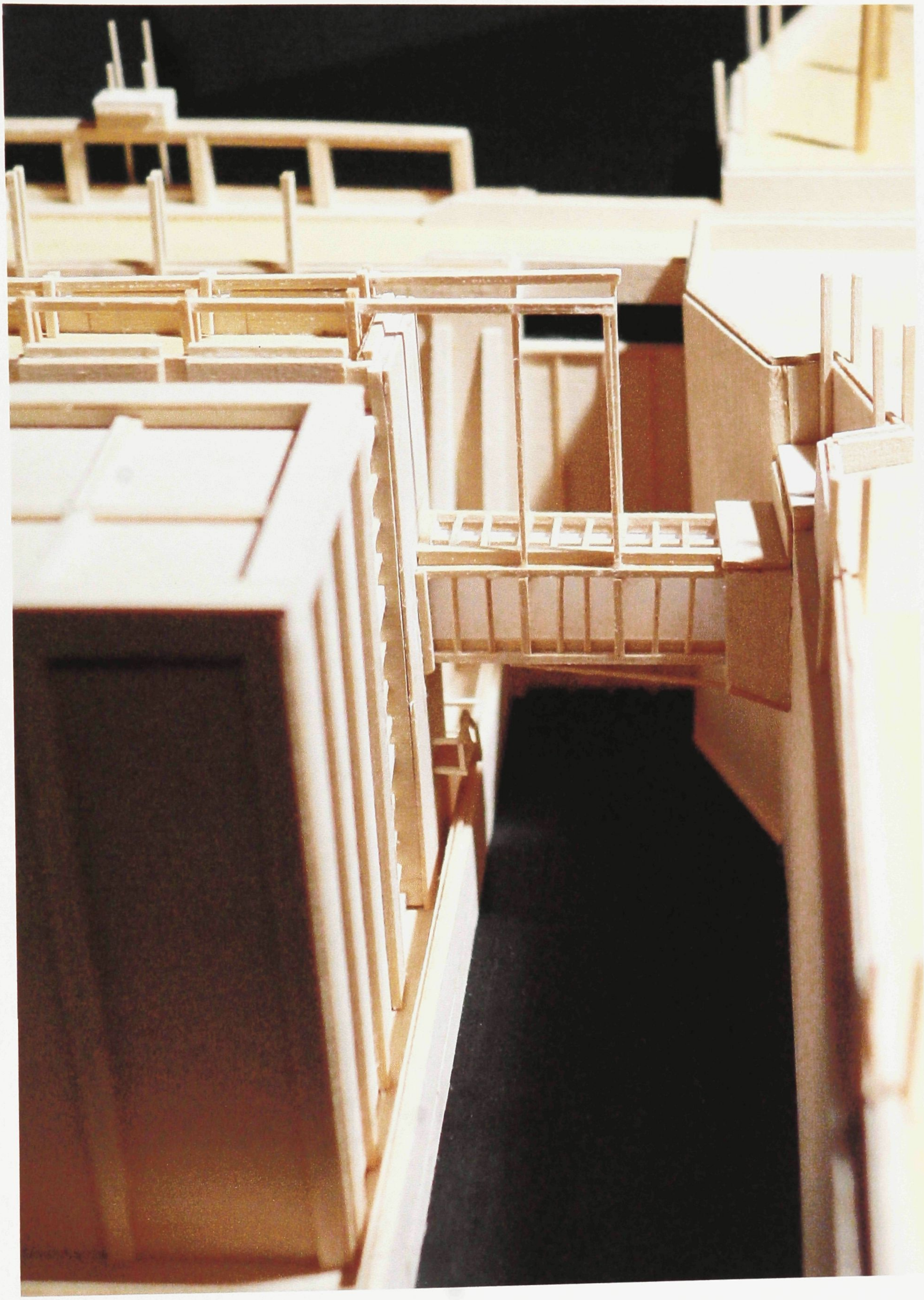

Fig. 51. *Pedestrian Bridge,* basswood model, 2005. Created by author.

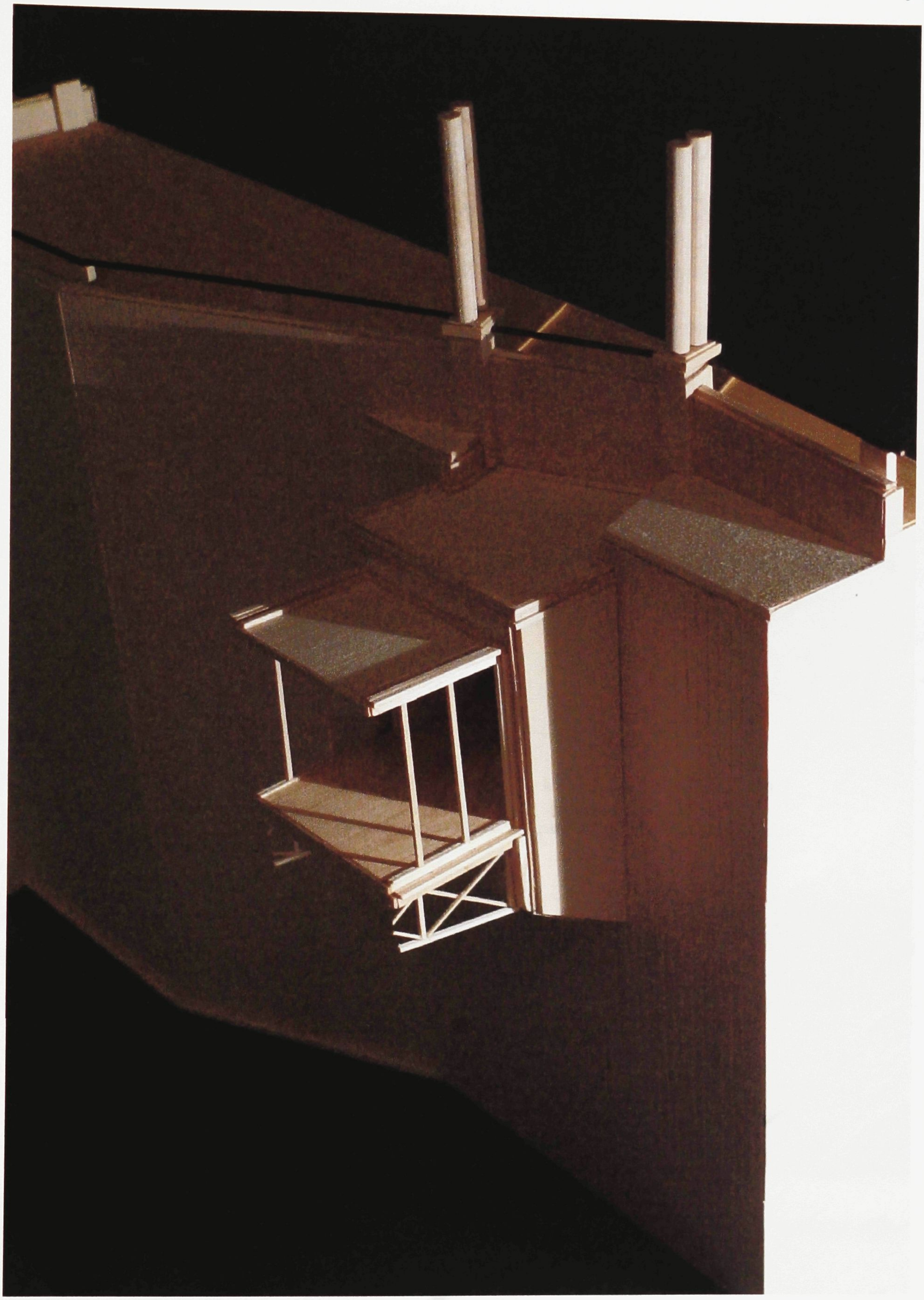

Fig. 52. *Pedestrian Bridge: Lateral Section,* basswood model, 2005. Created by author.

"Sustainability" is expressed architecturally in the circulation spine of the technological space, where the public visitor is placed between the technologies used to generate "green" electricity and views out towards the park and the city beyond via large south-facing windows. Following the pedestrian bridge the public visitor continues the descent via two long ramps within the circulation spine. This space is treated in a similar architectural fashion to that of the social spaces with the use of limestone and a consistent ramp system. After passing the windows on the primary descent, views are in turn opened onto the powerhouse beyond through a series of openings located between the vertical supports of the opposite limestone wall. These gaps give the public visitor an oblique view towards the powerhouse and the generating technologies, and thus form the initial connection with the operational sustainable technologies.

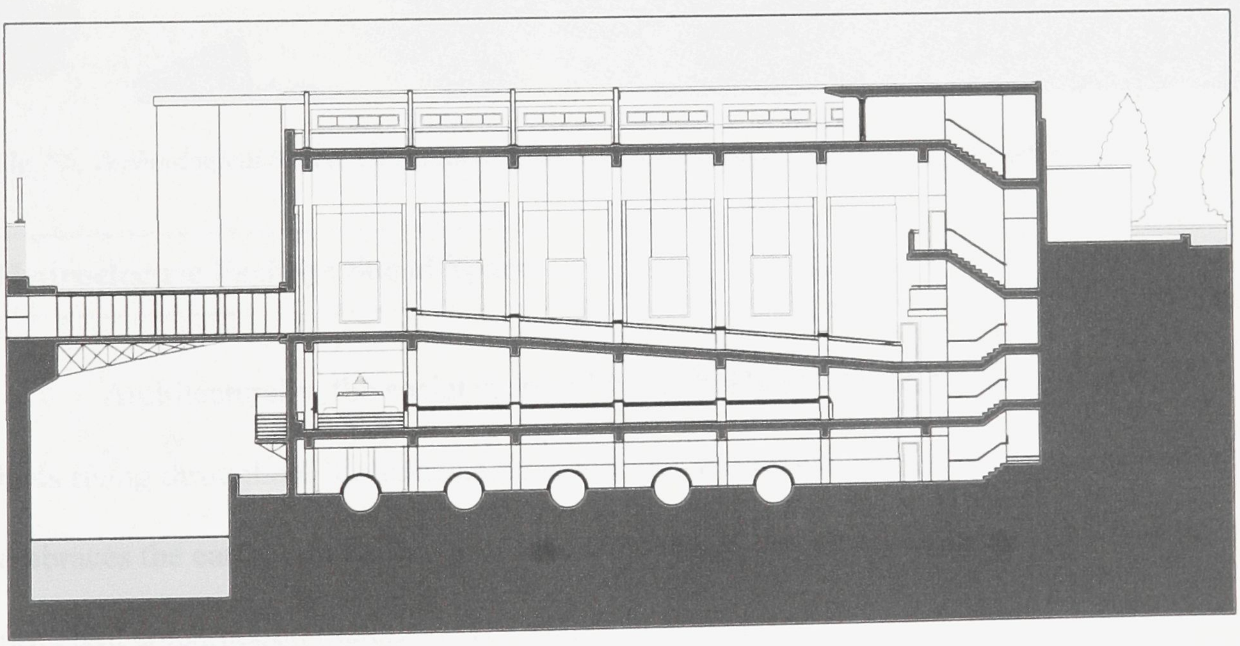

Fig. 53. *Technological Space: Longitudinal Section*, AutoCad drawing @ 1:400, 2005. Created by author.

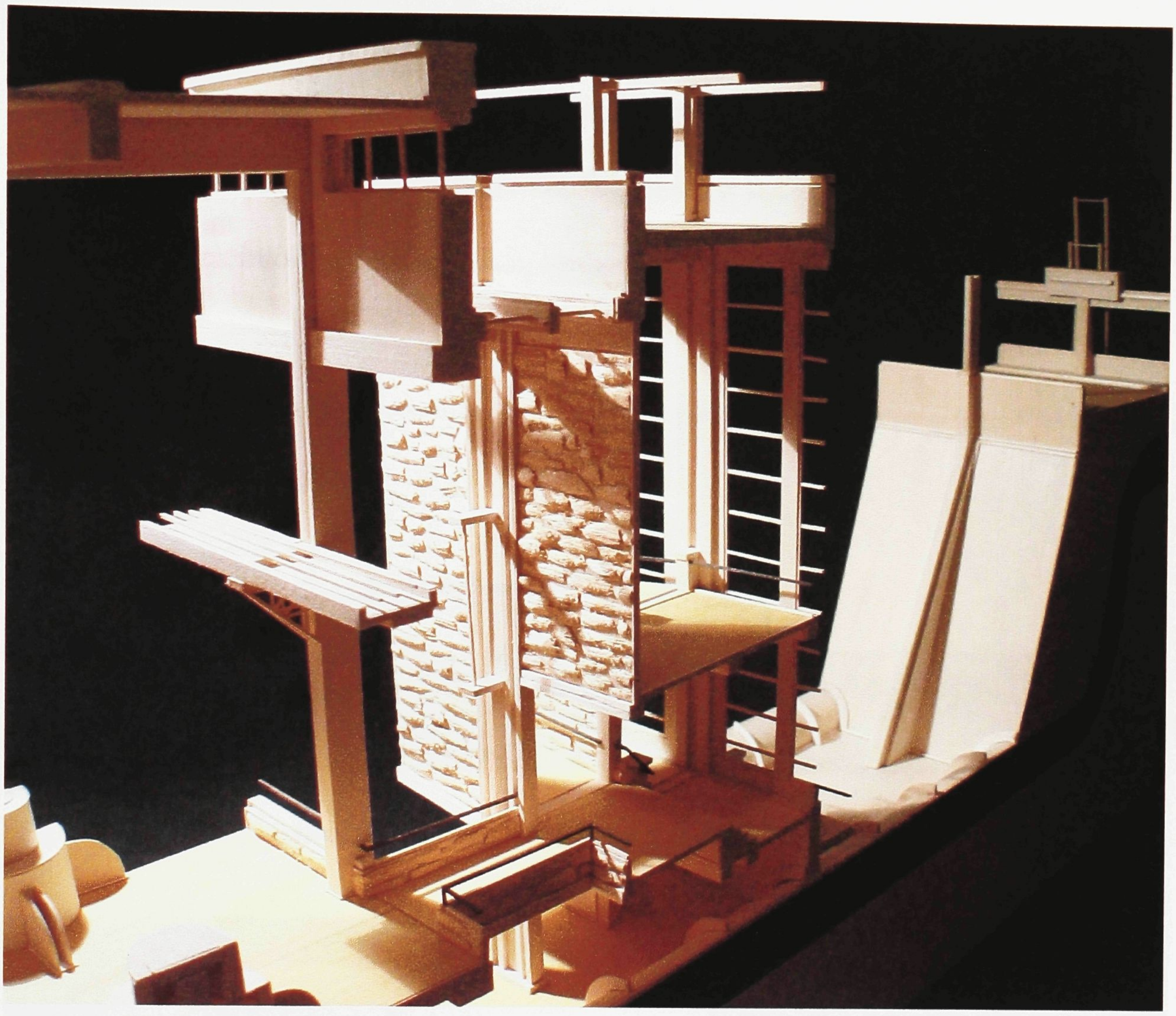

Fig. 54. *Technological Space: Circulation Spine*, basswood model, 2005. Created by author.

Hydroelectric Facility: Social Space

Architecturally, the social space of the hydroelectric facility is akin to the rock beds rising throughout the sustainable landscape. Rising 4m off the lower path system it embraces the earth with its low profile and the use of limestone, concrete and wood as principal construction materials. The façade is distinguished through glazed garage doors, that when rolled up, enable the space to be naturally ventilated. Similarly, the wide openings allow those sitting in the library to be visually connected to the park beyond. Surrounding the social space is a 1m deep body of water that supports recreational activities such as rowing in the summer months and skating in the winter, while supplying the principal watercourse with water during warm weather. Metal canopies that extend from the wide openings capture the daylight that strikes this moving water and by reflecting it back into the interior space, further connect the social space to the organic landscape.

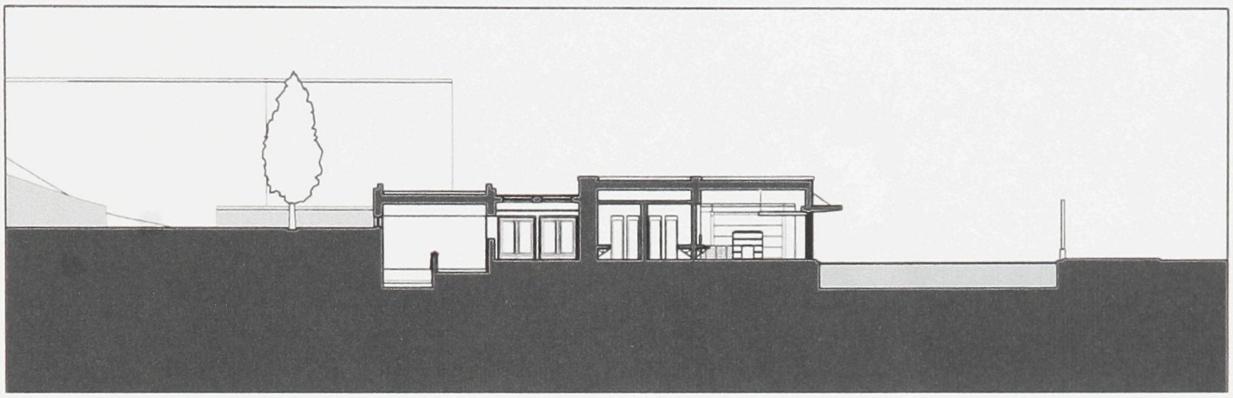

Fig. 55. *Social Space: Lateral Section,* AutoCad drawing @ 1:400, 2005. Created by author.

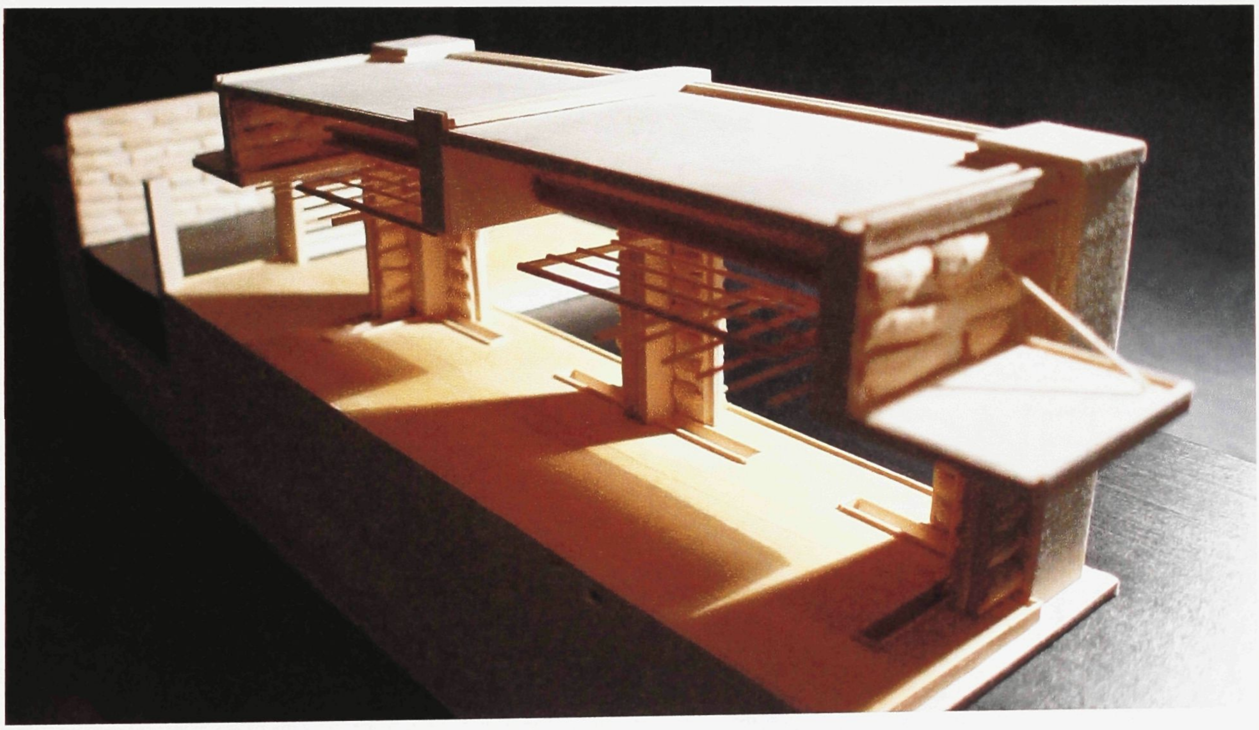

Fig. 56. *Social Space: Library,* basswood model, 2005. Created by author.

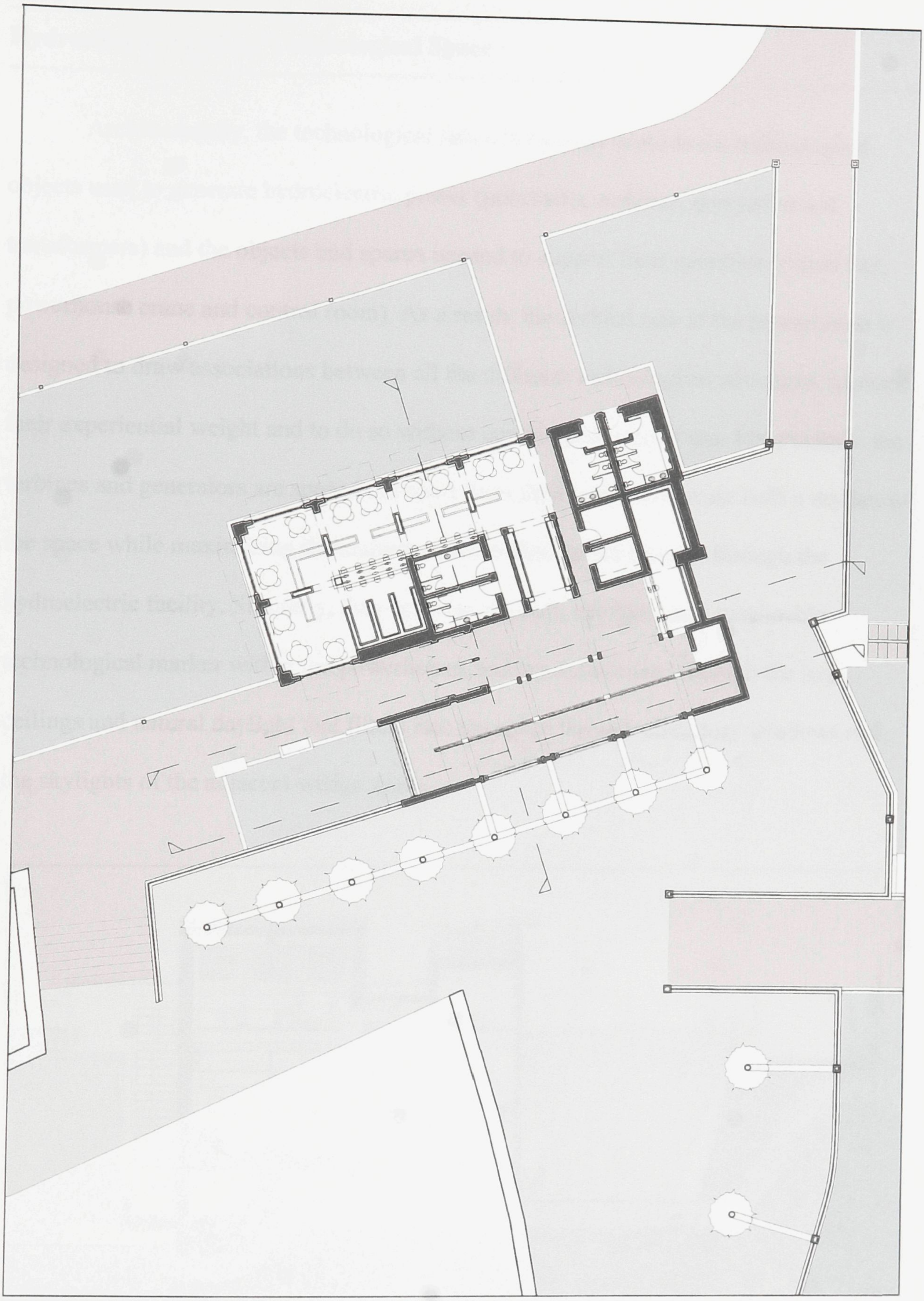

Fig. 57. *Social Space: Ground Floor Plan,* AutoCad drawing @ 1:400, 2005. Created by author.

Hydroelectric Facility: Technological Space

Architecturally, the technological space is focused towards the technological objects used to generate hydroelectric power (penstocks, turbines, generators and transformers) and the objects and spaces needed to support their operation (repair bay, powerhouse crane and control room). As a result, the architecture of the powerhouse is designed to draw associations between all the different technological structures, increase their experiential weight and to do so without compromising their use. For example, the turbines and generators are spaced 5m apart from their centres to create both a rhythm to the space while maximizing the amount of water that can be brought through the hydroelectric facility. Similarly, they act as an explicit, energetic and sustainable technological marker within the powerhouse, and are accentuated through the high ceilings and natural daylight that filters into the space through clerestory windows and the skylights of the adjacent wedge space.

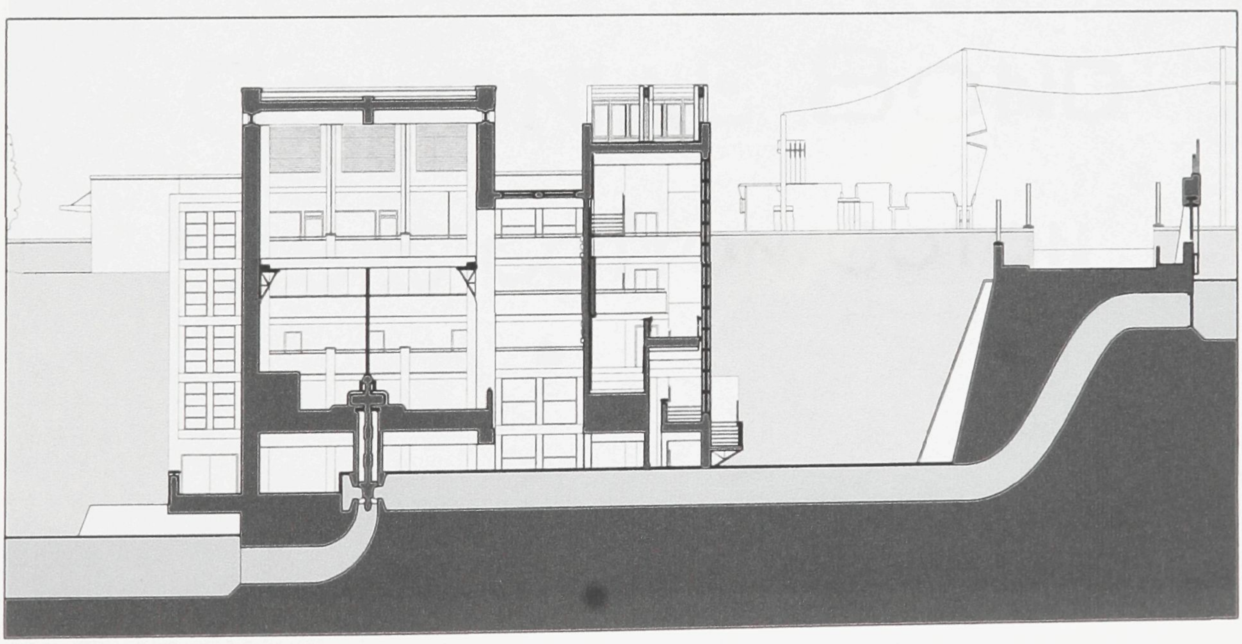

Fig. 58. *Technological Space: Lateral Section,* AutoCad drawing @1:400, 2005. Created by author.

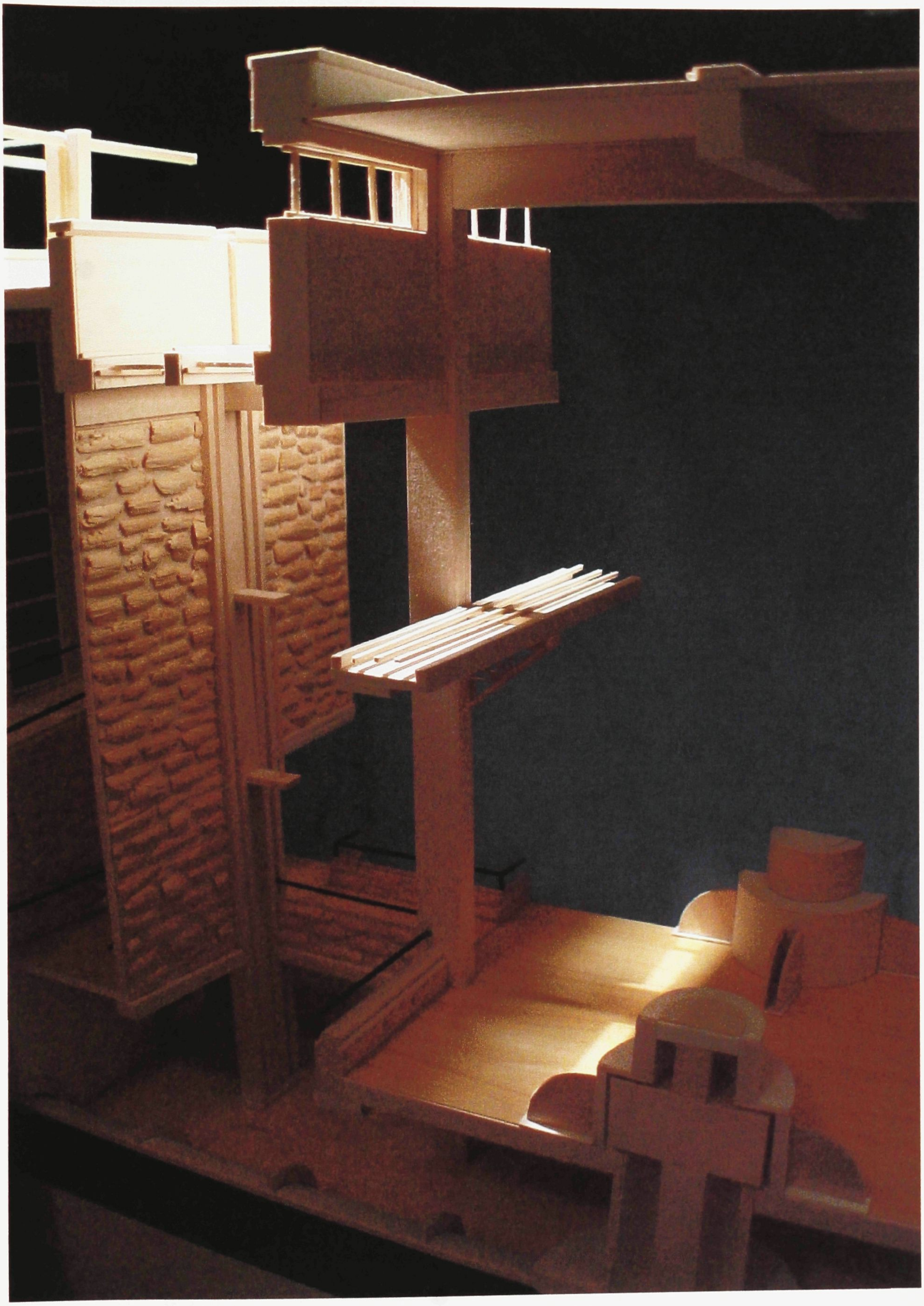

Fig. 59. *Technological Space: Powerhouse,* basswood model, 2005. Created by author.

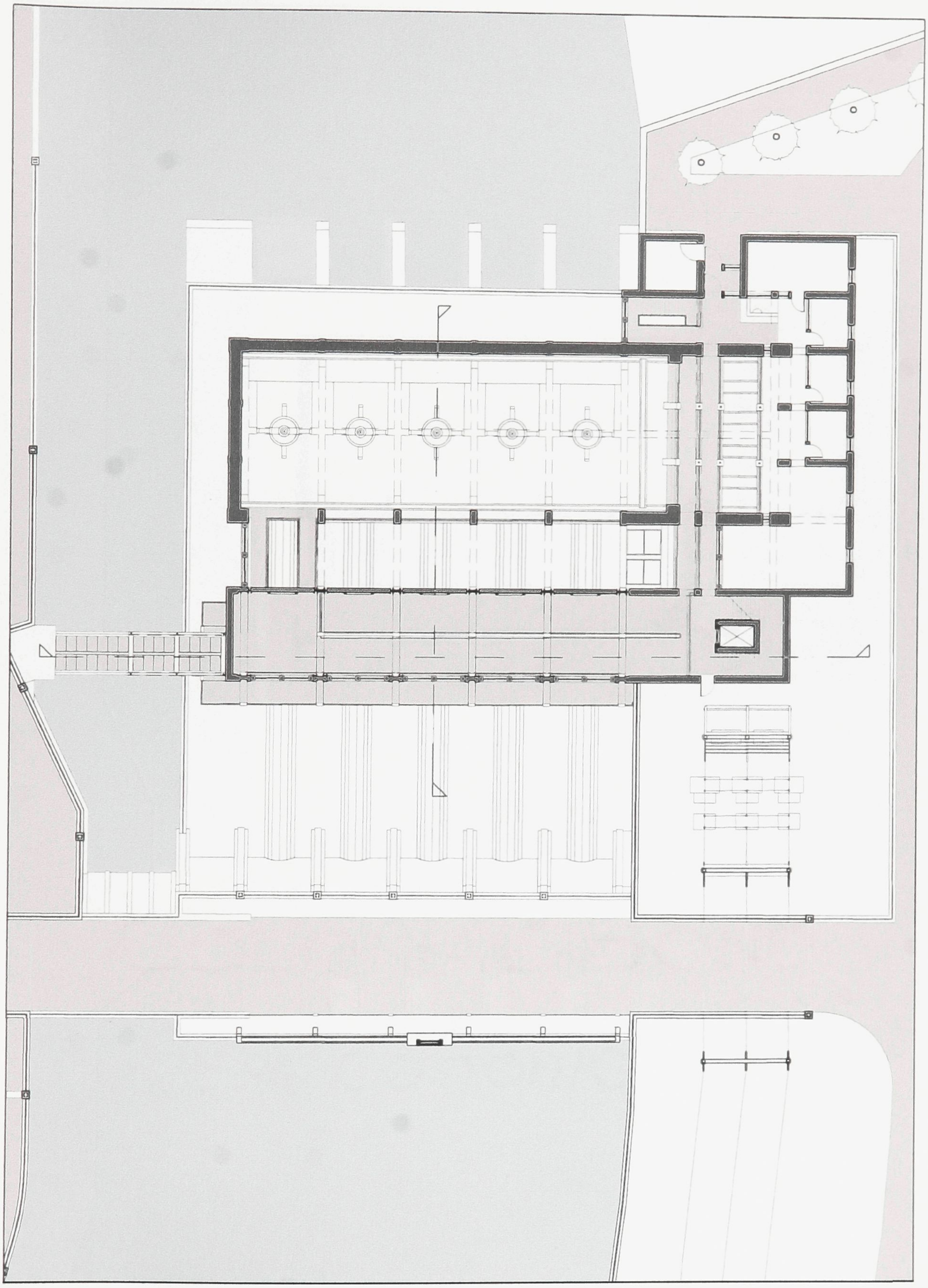

Fig. 60. *Technological Space: 1st Floor Plan*, AutoCad drawing @ 1:400, 2005. Created by author.

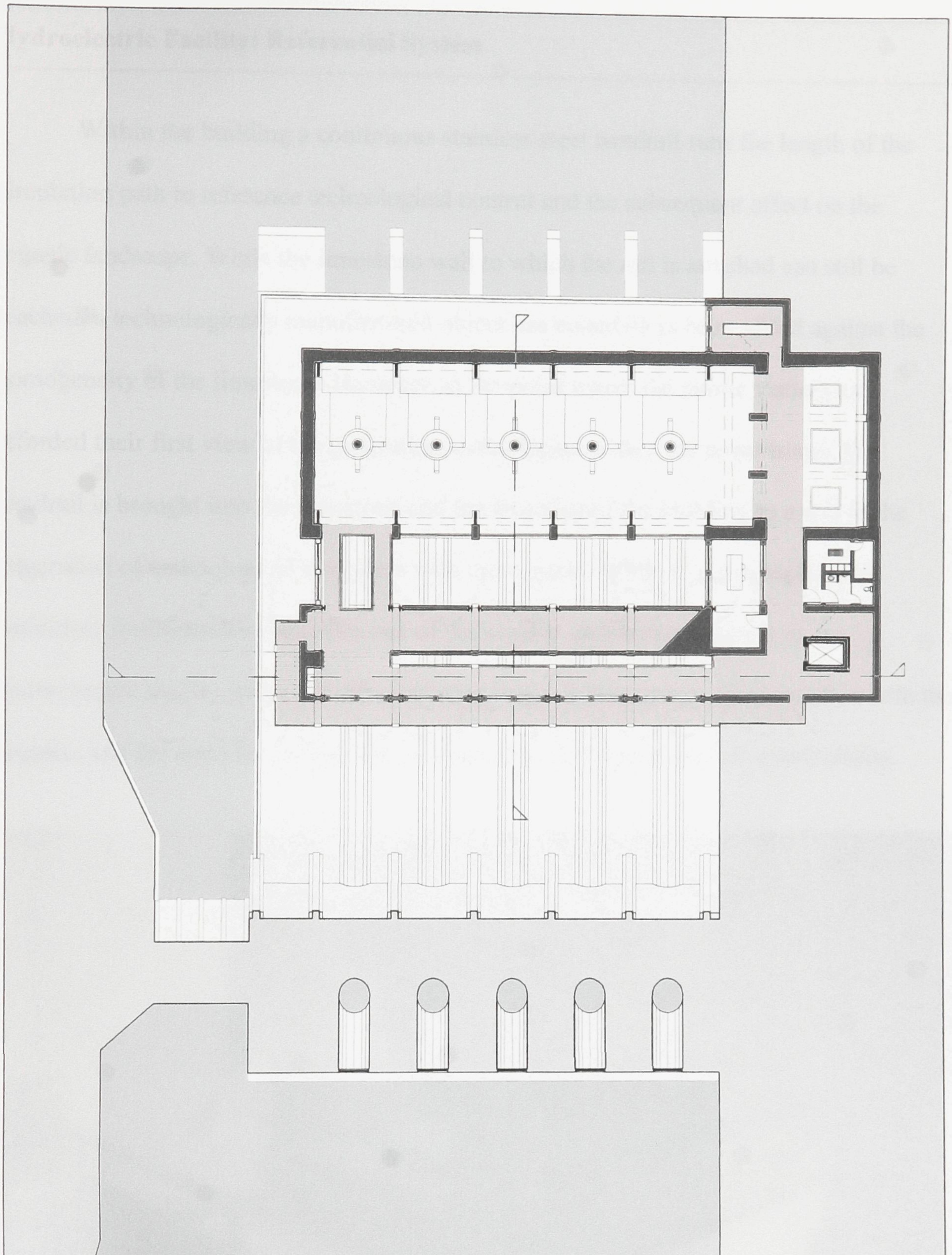

Fig. 61. *Technological Space: Ground Floor Plan*, AutoCad drawing @ 1:400, 2005. Created by author.

Hydroelectric Facility: Referential System

Within the building a continuous stainless steel handrail runs the length of the circulation path to reference technological control and the subsequent effect on the organic landscape. While the limestone wall to which the rail is attached can still be reached, a technologically manufactured object has nonetheless been added against the homogeneity of the limestone. However, at the point where the public visitors are afforded their first view of the generating technologies within the powerhouse, the handrail is brought into the limestone and the structure of the building as a nod to the integration of technological structures with the organic. While it is a metaphorical condition, it nonetheless inscribes one of the smaller architectural details in the hydroelectric facility with a narrative relating to our contemporary disassociation with the organic, and the need for subsequent re-integration through notions of sustainability.

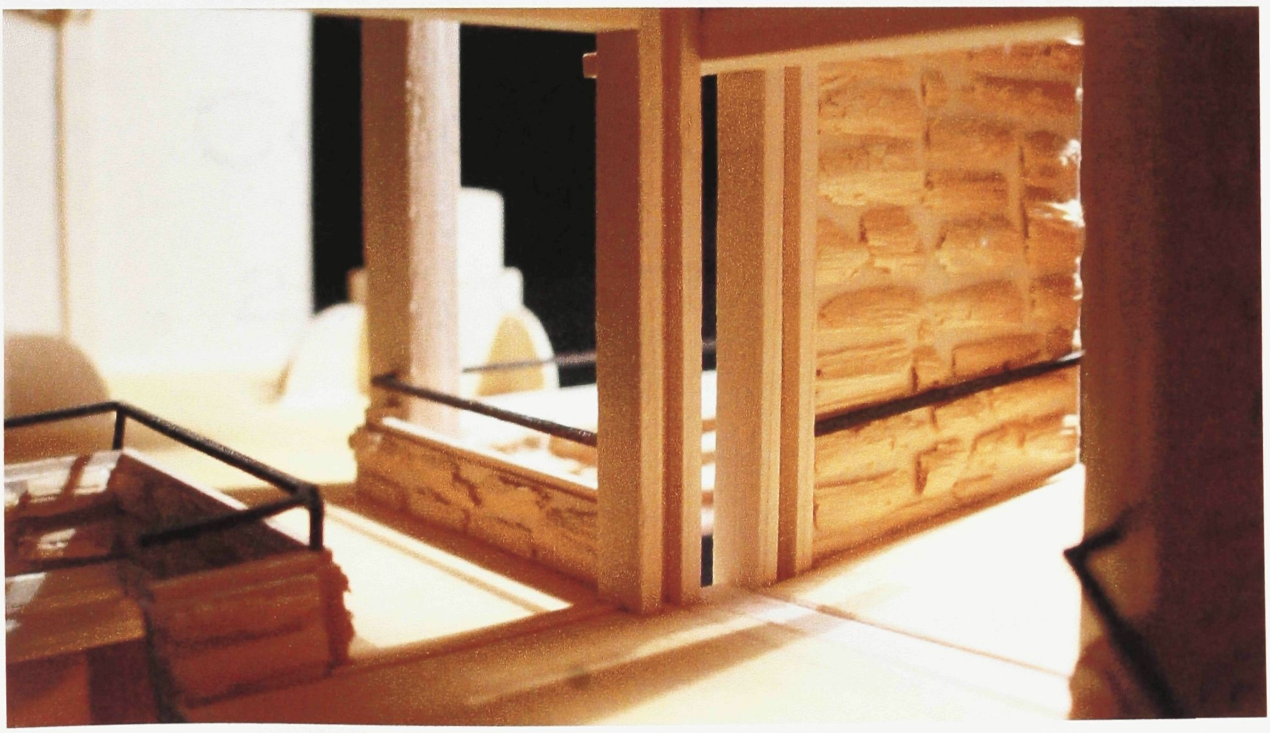

Fig. 62. *Hydroelectric Facility Referential System,* basswood model, 2005. Created by author.

Fig. 63. *Hydroelectric Facility: Synthesis*, basswood model, 2005. Created by author.

Reflections on the Sustainable Landscape

With the predominance of technological structures, operating or existing within modernity, it is sometimes difficult to separate ourselves from the use of technology. The architectural/landscape component of the thesis investigation illustrates this fact with the construction of three canals across the breadth of LeBreton Flats. As an act of technological control over the organic landscape, the canals, in some aspects, can be seen to run counter to sustainable principles. As a result, in retrospection of the thesis investigation, I might have considered alternative sites with pre-existing water features as the location for the sustainable landscape. In this capacity, the resulting architectural/landscape development could be more organically intertwined in place of its current focus on historical, infrastructural and technological conditions.

However, as the thesis investigation shows, power generation is the locus of all modern endeavors, and as the force behind its continued advancement, should become a celebrated public event within the urban environment. In this capacity, it has the potential to engage with a diverse public audience and form a direct and physical link with the places that it supports. If we couple the educational experience with a deliberate attempt at embodying sustainable principles, the resulting landscape in my opinion, is one of opportunity and growth that ensures both the continued vitality of the organic landscape and the continued use of the technology within our contemporary lives.

Part IV

(Autobiographical) Conclusion

Chapter 10: (Autobiographical) Conclusion

I was raised in Port Elgin, Ontario, a small town located on the shores of Lake Huron. With a population of approximately six thousand people it is a relatively quiet area with a good quality of life by North American standards. With white sand beaches and clear water, the area is also blessed with a natural setting free from the visible evidence of technology. This notwithstanding, the town is also supported and completely dependent on the proper functioning of a nuclear power plant that is situated fifteen kilometers south. With eight nuclear reactors the Bruce Nuclear Power Development (BNPD) is the largest nuclear facility in Canada and the primary means of employment for the majority of Port Elgin residents. My father spent his entire career working as a nuclear control technician at the facility, while my mother was employed briefly during its start-up period. Offering highly competitive wages and premium benefits, it provided and still provides families with a financial security package unequaled in the Bruce County region. With no large cities in the area, the town and surrounding communities benefit economically from the well-paid workers. This ensures a level of stability for the town and helps create a host of new jobs predominately in the service and tourism sector. The resulting economic structure is one of opportunity and growth, and aside from the BNPD site, there is limited industrial effect on the organic landscape of the region.

While we all take comfort in being well provided for, what is troubling in Port Elgin is that such stability is taken for granted. It is assumed that the power plant will always be in operation and provide new jobs. However, the truth of the matter is that nuclear plants have a fixed operating life of approximately fifteen to twenty years after which time they must either be shut down or refurbished at an exorbitantly high price. Constructed between 1978 and 1988 four of the eight reactors have already been refurbished, and the remaining four will undoubtedly have to be upgraded in the not too distant future. Since the BNPD site provides over one quarter of the province's electrical needs, the functioning of the station is vital to Ontario, but also to the small communities whose entire existence is predicated on its operation. Yet, for all its importance, the site is rarely visited or even comprehended by the local populations. Apart from those who work at BNPD, local residents would not be able to tell you how the facility operates, how the power is generated, and what are the associated environmental benefits and consequences.

Fig. 64. *Bruce Nuclear Power Development*, Tiverton, Ontario, 2002. Photograph by Bruce Power.

It was not until I left the area that I began to see that this *concealing*, to put in the context of Heidegger, was actually a symptom of the larger social attitudes towards technology. We accept technological structures in our lives unconsciously and uncritically, never really considering what are the effects of such use. To quote Edward Burtynsky, the acclaimed Canadian photographer who documents humanity's imprint on the organic landscape, "Our lifestyles are made possible by industries all around the world, but we take them for granted, as background to our existence." [59] What I could not understand however is why the BNPD site would remain as a "background" to my upbringing, rather than a place I could actively engage and ultimately, comprehend.

Nuclear power structures, such as BNPD, help support all modern endeavors. However, operating as an isolated monument within the organic landscape and outside of an urban realm, it is rarely experienced or even witnessed. While I remember visiting the BNPD site once as a child, the tour was conducted onboard a bus that traveled around the site, where the majority of those taking part were tourists. Those most affected by technological structures either had no interest in seeing them in context or when trying to do so, could only view the nuclear facility through the windowpane of the bus. While this is due to safety and security concerns, the public is nonetheless restrained from a direct engagement with, and an informed knowledge of, the processes and technological systems inherent to its power production. It was and continues to be an unfortunate social condition, whereby we remain physically and physiologically divorced from the technological processes operating around us.

Whatever position one might take regarding nuclear power, the fact of the matter is that the BNPD site, as *every* power generating plant or station, is exactly as removed

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[59] Lori Pauli, Manufactured Landscapes, (Ottawa: National Gallery of Canada, 2003) 54.

from the realities of our lives as it is from the mainstay of our lives. It is as intangible as the very energy that courses through the wires, transformers and outlets that demarcate our built landscape. This thesis was thus undertaken to see if this divided reality has to be the case.

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