A Contaminated Landscape in an Urban Land Use Context

The Transcona Domtar Site

by

H. Grant Brumpton

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A CONTAMINATED LANDSCAPE IN AN URBAN LAND USE CONTEXT THE TRANSCONA DOMTAR SITE

BY

H. GRANT BRUMPTON

A Thesis/Practicum submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements for the degree of

MASTER OF LANDSCAPE ARCHITECTURE

I dedicate this to my parents, Carol Ann and Greg Brumpton.

Abstract

Past land use practices have produced urban and regional sites that are characterized by few positive social, economic, or ecological characteristics. These sites often result from the aftermath of now obsolete technologies and the presence of remnant contaminants. Contaminated sites within an urban context, where exposure to contaminants by people is most likely, may also be under pressure for reuse development.

The study proposes a synthesis of the issues surrounding a contaminated site into the preparation of an appropriate site design proposal. Issues considered include the perceptions held by those who may use the landscape, special regulatory conditions that apply to future land use options and the technical requirements of the remediation strategy.

The setting for this study is on the outskirts of the community of Transcona in Winnipeg, Manitoba. It is the site of a former Domtar Chemicals Limited wood treatment plant. The wood treatment plant operated for 65 years, during which time the soil was contaminated with creosote and pentachlorophenol. Attempts to clean the soil have been ongoing for over a decade, much to the distress of people living as close as 30 metres from the worst areas of contamination.

The result of this study is a site design proposal that provides the opportunity for the healing of perceptions. Healing is accomplished by increasing awareness through the design of a program that focuses on environmental education and interpretation.

Acknowledgments

I wish to take this opportunity to acknowledge the guidance and support received from my practicum committee of Dr. Les Fuller of the Department of Soil Science, Dr. Mary-Ellen Tyler of the Department of City Planning and the committee chair, Professor Charlie Thomsen, Head of the Department of Landscape Architecture.

I would like to acknowledge the interest and cooperation received from Ed Yee, Manager of Contaminated Sites and Dave Wotton, Director of the Dangerous Goods Handling and Transportation Act for the Winnipeg Region, at Manitoba Environment as well as Mark Baron, chair of the Lakeside Meadows Residents' Association.

I would also like to acknowledge the contribution made by my peers who participated in the community survey and Transcona Domtar site design studio in the fall of 1993, for providing me with many valuable insights and starting points.

And finally, I would like to thank family and friends for their patience, encouragement and support during the preparation of this study.

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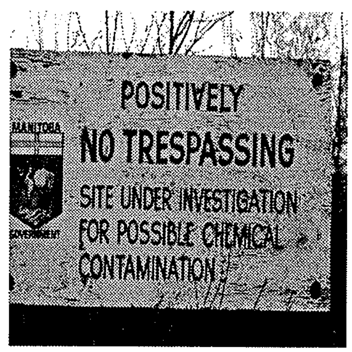
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1

Introduction

Decades of industrial and other related land use activities have produced urban and regional sites that are characterized by few positive social, economic, or ecological characteristics. This situation often results from the aftermath of now obsolete technologies and the presence of remnant contaminants. In attempting to respond to the environmental impacts inherent in polluted sites, the extent to which technology and past practices have impacted these places has come to light. Robert Thayer, a noted author who has addressed the relationship between nature and technology in his book *Gray World Green Heart*, sums up this situation by stating that; "*Technology has become the tool of human evolutionary success as well as the cause of much environmental damage and social distress*." (Thayer, p. 140). The potential economic value of contaminated sites in the urban environment, coupled with greater environmental awareness in society, has focused attention on this type of site.

Risk analysis, followed by remediation, are each required for sites with significant health risks associated with them. Sites within an urban context, where exposure to contaminants by people is most likely, can often require the greatest remediation efforts. Contaminated sites within an urban context may also be under pressure for reuse development. A series of unique issues surround the broader scope of activity associated with reuse design when combined with remediation. Reuse design in the context of remediation must take into consideration the opportunities and constraints associated the site. These include perceptions held of the site, special regulatory conditions that apply to future land use options, as well as past and current land use including ongoing remediation activities.

The study site chosen as the basis for this practicum is a former Domtar Chemicals Limited wood treatment plant located on the eastern outskirts of the community of Transcona in Winnipeg, Manitoba. As an introduction to the site, which is analysed in depth in section 3.0, the wood treatment plant operated for 65 years. While in operation, the plant polluted the soil with creosote and pentachlorophenol (PCP). Efforts to remediate the site have been ongoing for over a decade, much to the distress of the residents living as close as 30 metres from the worst areas of contamination. Complications in the remedial effort have mainly arisen from the special soil conditions on the site (UMA, 1996).

1.1 Objectives

The main objective of this practicum is to explore the issues surrounding a heavily disturbed site in an urban land use context and to then synthesize this information into the preparation of an appropriate site design proposal. Specific objectives are as follows:

- To critically consider what constitutes an appropriate design response to a heavily disturbed site that contains some level of contamination as it relates to potential land uses and the perceptions of people who may use the site in the future.
- To examine existing regulatory land use criteria pertaining to the Transcona Domtar site and to evaluate the strengths and limitations of these criteria in facilitating reuse design.
- To work with the opportunities and constraints presented by the existing risk analysis and remediation proposal to

prepare an appropriate design proposal for the Transcona Domtar site.

1.2 Methodology

A literature review of related design precedents for sites heavily disturbed by past or ongoing land use activities was undertaken as the first step of this practicum. The review of precedents has been compiled and analysed to identify a typology of sites and design responses. Eight distinct site designs, three of which are artistic responses to heavily disturbed sites, have been chosen for analysis.

A site inventory and analysis was undertaken for the Transcona Domtar site. This section highlights traditional site analysis components such as the characteristics of the soil, vegetation, ground water and climate. It goes on further to analyse the nature of the contamination, the nature of the strategy used to remediate the site, as well as the risk analysis undertaken by the environmental consultants. Surveys of adjacent residents and school children were undertaken to analyse perceptions and use patterns relating to the site. Contaminated site recommendations from the Canadian Council of the Ministers of the Environment, Manitoba government regulations and City of Winnipeg zoning bylaws were examined in the context of their application to the selected site. Opportunities and constraints derived from the analysis of the preceding information were used to identify criteria for landscape design and development that best responds to the particular landscape and unique characteristics of the Transcona Domtar site.

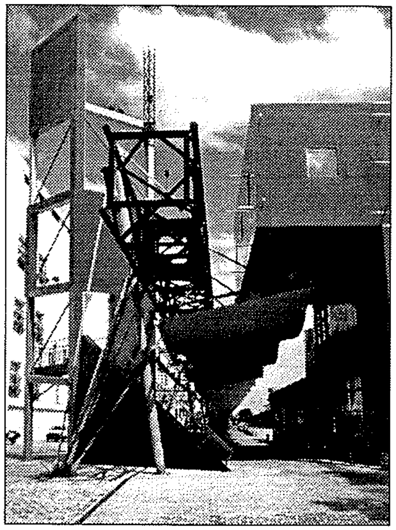
Finally, a site design proposal was put forward using the opportunities and constraints identified in the previous sections. A synthesis of the information generated through the previous phases has generated a site program of appropriate activities and has also contributed to their spatial organization on the site. The design proposal for the site is presented as the final phase in the form of site plans, drawings and a written text.

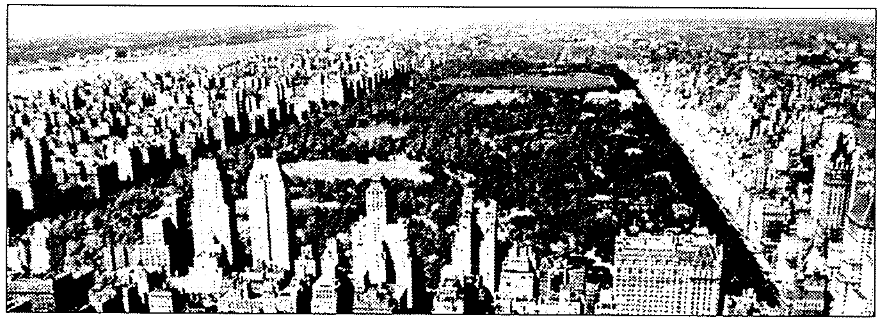
2

Precedents

A review of precedents that demonstrate how sites disturbed by previous or ongoing land use have been addressed by artists and landscape architects has been compiled and analysed to identify a typology of sites and design responses. Concluding remarks will extract several consistent design responses found in the study of the various precedents. The review of precedents will begin with a brief overview of the time period prior to the middle of the 20th century as well as an overview of selected projects outside of North America. The overview will be followed by a study of specific design precedents that have characteristics in common with the chosen study site and offer unique responses to sites that have been disturbed by past land use practices.

Prior to contaminated landscapes becoming an issue for society, land has always been redeveloped because it was perceived as having little or no social or economic value. The intent of past redevelopment of unvalued sites has been to increase the value of the land itself as well as the value of the surrounding land. An example from recent history is Birkenhead Park in England, constructed in 1843, which was "*the first built and owned*





Title Page: Shown is a detail of the stone work found in Harvey Fite's earthwork, Opus 40. Source: Architectural Digest, *March 1989.*

Top Left: Parc de la Villette, in Paris. Source: G. Brumpton, 1995.

Top Right: Central Park in New York City designed by Frederick Law Olmsted in 1857. Source: Landscape of Man, 1988.

by the public specifically to ameliorate its own industrial conditions" (Jellicoe, 1987). At Birkenhead Park, the land redevelopment was intended as an amenity to counteract the social impacts of the industrial revolution. Redevelopment succeeded in increasing the social value of the land. Another response was the development of land unsuitable for agriculture or building into public open space which, in turn, promoted redevelopment in the surrounding region. Central Park in New York City, designed by Frederick Law Olmsted in 1857, is an early example of this phenomenon occurring in North America. The site of Central Park was originally land that was unsuitable for building development or agriculture and was thus designed as a public open space. By providing a socially valued public amenity, the economic value of land surrounding the park has increased so much that the tax revenue generated there has paid for the park land purchase and redevelopment several times over. A contemporary example of this redevelopment pattern outside of North America includes Parc de la Villette in Paris, which was constructed on the site of a former slaughter house (Tschumi, 1993). By using public funds to build Parc de la Villette the French government has spurred commercial and residential redevelopment in the surrounding areas. This has been seen as socially and economically beneficial to the city of Paris as a whole.

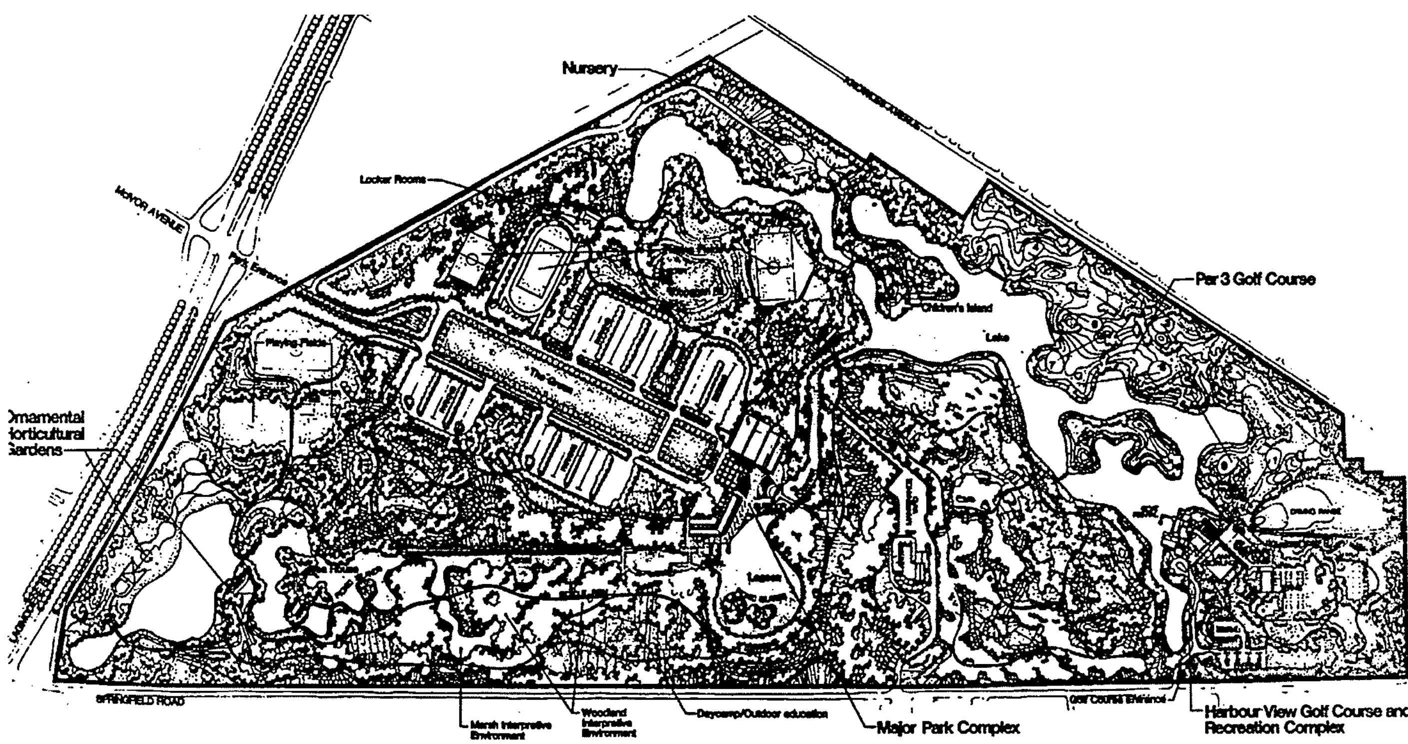
With those previous examples, it has been shown that the redevelopment of land within urban environments has been socially and economically successful. Eight precedents have been selected to reinforce this premise and to demonstrate alternative solutions to the challenges of sites disturbed by previous or ongoing land use. Included are five site designs, four of which are Canadian examples, and three earthworks or land sculpture projects . All demonstrate unique design responses to heavily disturbed landscapes.

2.1 Kilcona Park, Winnipeg, Manitoba

Kilcona park came into existence in the early 1970's as the result of the planning efforts of three City of Winnipeg departments. The Parks and Recreation Department saw the need for a new regional park to serve a rapidly growing northeast section of the city while the Waterworks and Waste and Disposal Department was considering a site in that area to create storm water retention ponds. The 172 hectare site chosen for the project was also being studied by the Works and Operations Department as a potential landfill. This park is an excellent example of a landfill reclamation that demonstrates some important design principles worth noting. The first of these principles is that while parks on top of landfills are not a new idea, they have traditionally been an afterthought applied to the sealed landfill, rather than deliberately planned from the beginning of the landfill's development. Kilcona Park is a helpful precedent to examine because future land use was considered from the outset of this development.

Another important factor that the Kilcona Park planning and development process demonstrates is the use of extensive public consultation. Area residents, whose residences surrounded the site from the beginning, had

Shown below is a plan view of Kilcona Park, located in Winnipeg, Manitoba. Source: The City of Winnipeg Parks and Recreation Department 1993.



their concerns thoroughly considered. Their reactions can be classed as the "*not in my backyard*" or NIMBY syndrome. The majority of fears voiced by the residents centred around odours, rodent pests, visual and noise pollution, and decreased land values. All of these fears where addressed during the planning process as the City of Winnipeg, working with the consultants from Lombard North Ltd., brought the residents directly into the design process through community surveys and regular public participation meetings. Several devices were used to address the community's concerns. The two central landfill areas were surrounded by a 300 metre buffer zone which consisted of park space, earthen berms, trees and fencing. The central purpose of the buffer was to arrest any visual or noise pollution and to stop any litter that may have blown from the site.

Filling of the Kilcona site has recently ceased. It took twelve years for the site to reach capacity. The landfilling activities provided the opportunity to create unique landforms on the prairie landscape while the need to develop storm water retention ponds provided the opportunity to create lakes suitable for a variety of recreational activities. Each of these amenities has contributed to the area's quality of life. Rather than reducing adjacent property values as was first feared by residents, the completed project has actually increased property values.

Shown below is the plan of Wildlands Park located in Calgary, Alberta. Source: Petro Canada Ltd.

2.2 Wildlands Park, Calgary, Alberta

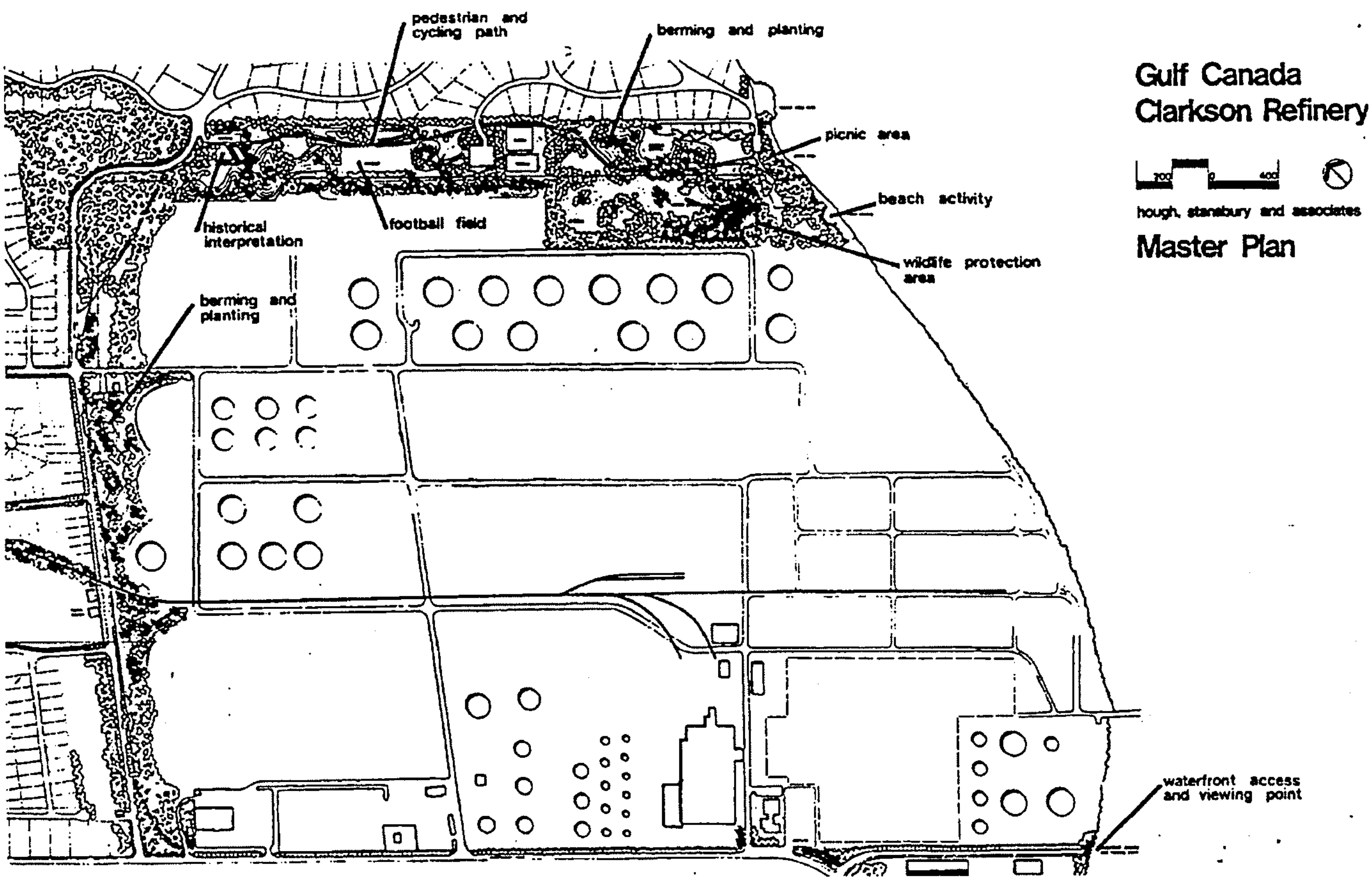
Wildlands Park is an example of the reuse design of a site disturbed by past land use that also contains residual levels of contamination. The 33 hectares of Wildlands Park was previously utilized as an oil refinery beginning in 1939. The refinery was eventually purchased by Gulf Canada, who had dismantled the operations by 1985. The ground water of the site had been inadvertently contaminated with hydrocarbons during the operation of the refinery. The pumping of the oil from the ground water was expected to take 20 years. As a result of the time span involved, these remediation activities needed to be incorporated into the park's final design.

Discussions began regarding the future use of the land as a wilderness park between Petro Canada, who were the current owners, the Rotary Club, the City of Calgary, and the Inglewood Community. The park was developed in stages with the intent of the design being to create three different habitats. The habitats desired included a wetland, a grassland, and a forest. Debris such as metal pipes, concrete foundations and structural steel was buried in the soil. This material was removed even though it posed no contamination risk and did not impede plant growth. Top soil was added to increase the fertility of the soil. Finally, the park was designed to be essentially self-sustaining and would therefore require little if any maintenance.

2.3 Clarkson Refinery, Mississauga, Ontario

The first consideration of this case study is that it involves an active oil refinery and, as a result, is not really a project directly involving a contaminated site. The refinery existed prior to the building of the surrounding housing and was subsequently forced to address this conflict in land use

Shown below is the plan of the Clarkson Refinery grounds in Mississauga, Ontario. Source: Petro Canada Ltd.



through design, much like the encroachment of the housing developments around the Transcona Domtar site. The landscape design proposal developed and implemented became a screen to buffer the industrial activities from the surrounding neighbourhoods.

The Clarkson Refinery is located in the south west corner of Mississauga, Ontario. It is bordered to the north and east by low density residential housing, Lake Ontario to the south, and industrial lands to the west. The east perimeter is formed by a large multiple use park, known as Meadow Wood Park, that was deeded to the city of Mississauga in 1960 to provide a buffer between the refinery in its new residential neighbours.

The main objective of this project was the provision of screening, buffering and amenities for the surrounding communities in order to maintain good relations with the residents. The site was fortunate to have an extension of mature maple and beech woodlands and lowlands crossing its northeast corner. Adjacent undeveloped fields on the site were regenerating into woodland. There was little other significant vegetation except for a line of over-mature poplar along the roads bordering the west and southwest. A small marsh at the south end of the site was favoured by nearby residents.

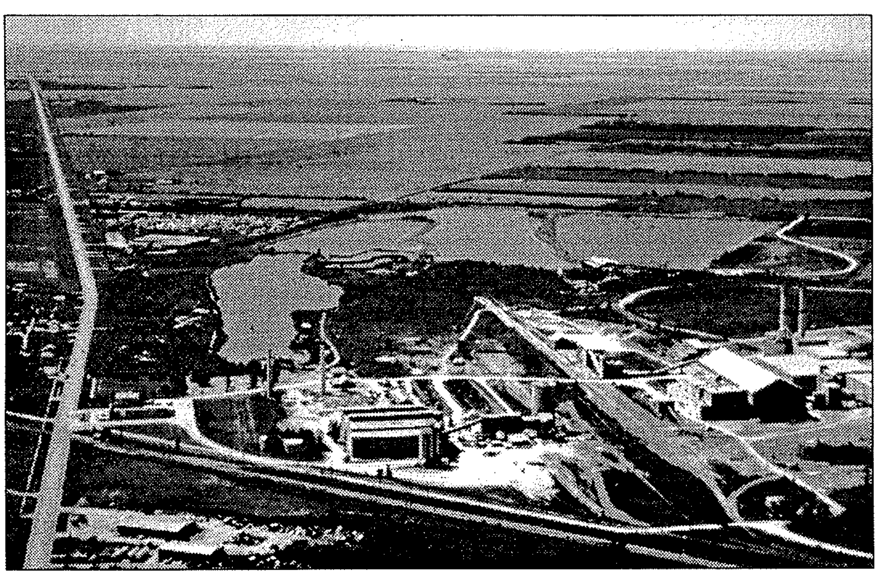
Another reason why this project was chosen as a precedent was that the design process at the Clarkson refinery site involved a substantial amount of public consultation. Several critical site issues where voiced by the neighbouring communities during this process. The first major concern expressed was the lack of an adequate buffer zone and screening along much of the west perimeter of the refinery. This condition resulted in a high visual exposure of oil storage tanks and other industrial elements, in addition to noise problems. Second, there were areas of poor drainage in the northeast corner of Meadow Wood Park that contained an existing playing field, and cycling/pedestrian paths. The final concern was the poor access to the waterfront through Meadow Wood Park, despite its hard linear quality, and its lack of connectedness to the surrounding areas. Resulting from these concerns, several interventions were undertaken. There was a general replanning of Meadow Wood Park to improve its overall effectiveness; waterfront and marsh access; and a softening of its hard linear quality. There was also a relocation of the playing field to an area where it could be more effectively drained and the construction of a walkway system to be connected with a proposed city bikeway system. Berms with heights in the range of 2.5 to 5.6 metres, as well as densely planted trees and shrubs, were used as visual screening.

This site was completed in 1981, after two, four-year stages. The design provides recreational amenity desired by neighbouring residents and addresses functional concerns dealing with noise and visual pollution in response to a change in surrounding land uses.

2.4 Fort Whyte Centre, Winnipeg, Manitoba

The Fort Whyte Centre is another example of a site heavily disturbed by past land use. It is located in Winnipeg, Manitoba. Clay was mined from the ground in open pits beginning in 1911. The mining began using horse-drawn scrapers but ended with contemporary diesel-powered trains and dredging apparatus. Twelve metre deep pits where generated from the mining activities. These pits have filled with water and have become popular spots for migratory birds. The clay was used in a process to manufacture cement in a nearby plant operated by Canada Lafarge Cement. Activity on this site continued until 1982 when the kilns were finally shut down as a result of increasing transportation and energy costs.

Currently, the 87 hectare site is the home of the Fort Whyte Nature Centre, a private, non-profit environmental education centre. The activities of the education centre are focused around the migratory birds that pass through the site as well as deer and other small mammals that inhabit the wetlands. The interpretive centre houses among others, displays devoted to energy conservation, an aquarium of fish species native to Manitoba, a



An aerial view of the Fort Whyte Centre shows the close proximity of this site to industrial land use. Source: The Fort Whyte Centre, *1994.*

gift shop and space for conferences. Similar to Wildlands Park discussed previously, the focus of the development at Fort Whyte has been on the creation and maintenance of habitats and their interpretation by the 50 000 people that are estimated to visit the site annually (Fort Whyte Centre, 1995).

2.5 Earthworks

Another response to sites heavily disturbed by past land use has been generated through the works of various sculptors. These works have been categorized as conceptual art or earthworks. Conceptual art can be described as; "*an idea in the mind of the artist, materializes as process, assumes whatever tangible shape it may, then disappears into memory or oblivion. Some like earthworks have great permanence.*" (Fleming, 1986). The most prolific period of work for this group was after the cultural turbulence and social unrest of the late 1960's and early 1970's. Influenced by the Mayans, Aztecs, and Incas, these artists explored the symbolism, the mystery and the expression of culture on the land. Their artistic expression was one that not only used the materials of the land, but was bound to the genius of the place which results in an intensification of the relationship between the participants and their surroundings.

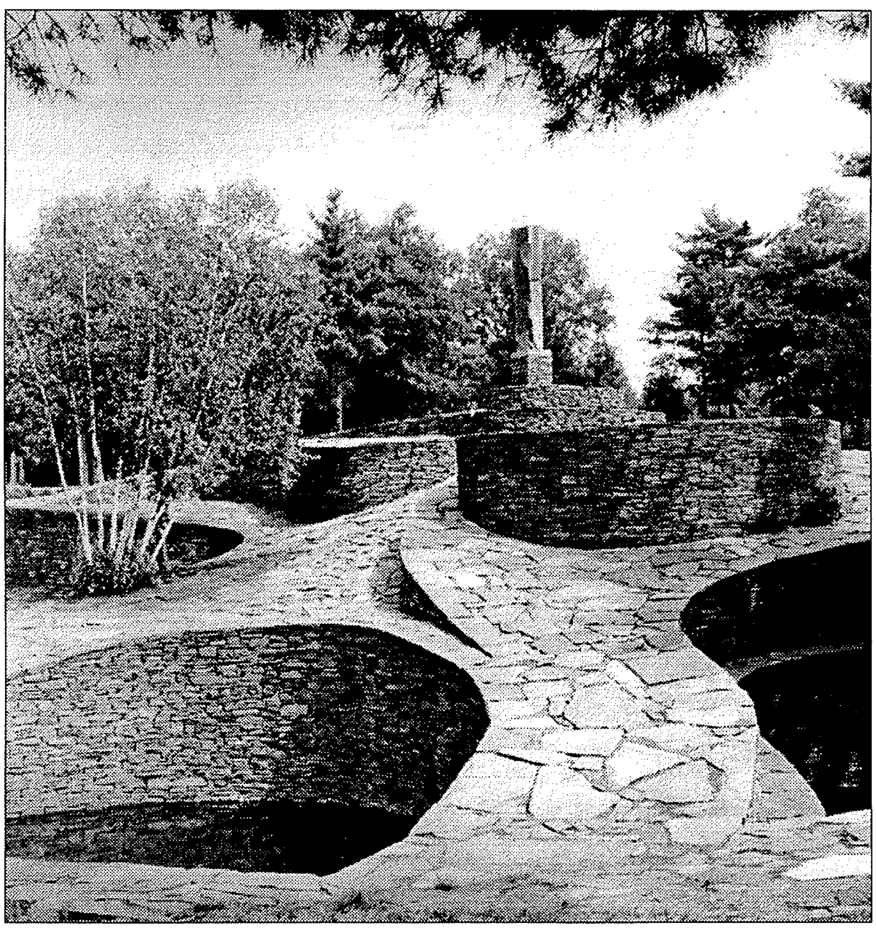
Earthworks is a term widely used to define those artists who have chosen to enter the landscape itself. Not all artists that worked in the landscape addressed landscape disturbance or reclamation, but many of the key examples of these artists did, most notable of them was Robert Smithson. But before Smithson, the first artist to engage the landscape through his work was Harvey Fite in an unfinished work entitled Opus 40.

2.5.1 Opus 40

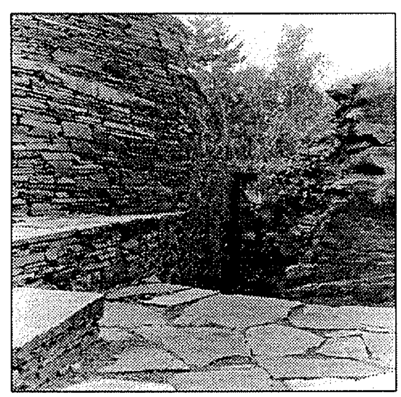
Harvey Fite's only earthwork project, begun in the late 1930's at a deserted blue stone quarry in the Catskill mountains of southern New York, was the first recorded project of its kind (Beardsley, 1989). This project is seen as a very early precedent to the later avant garde, conceptual, or earthwork artists such as Smithson.

Fite's project began as he used the quarry stone as material for his carvings. As he carved away at the quarry walls for material, he became interested in the change of form of the landscape that resulted. He abandoned his earlier sculptures and began a design of the place, creating terraces and curving ramps that covered an area of approximately 2.75 hectares. What is particularly relevant with this work is that it is seen as in harmony with the landscape. This is contrary to many other earthwork projects that followed. As Gill states;

> *"In recent years, earthworks have become a popular - even fashionable - species of sculpture; in many cases, these works amount to little more than the imposition of an artist's powerful ego upon a helpless landscape. Opus 40 serves an altogether different purpose. We feel in its presence, as Fite would wish us to feel, not that it is a monument to a particular sculptor's talent and energy but that it is rather, a propitiatory offering - a recompense in the form of art for the violence done to nature in the initial*



Shown to the left and below are the curvilinear forms and dry stone detailing of Opus 40 by Harvey Fite. This project is located in the Catskill Mountains of New York. Source: Architectural Digest, *March 1989.*



blasting open of the quarry, the century-old salvaging of a tranquil Catskill hillside." (Gill, 1989)

Opus 40 is important because it is the first project of its kind, and because it represents a sensitive expression of design on a site heavily disturbed by past land use.

2.5.2 Sky Mound

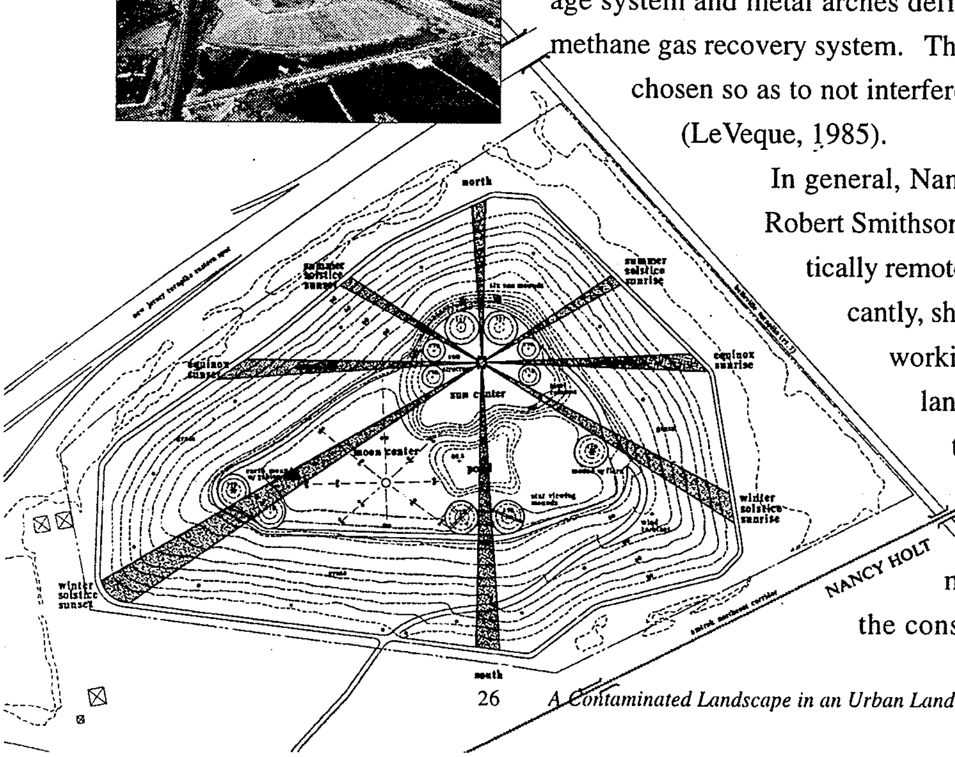
Like Kilcona Park in Winnipeg, Sky Mound is built upon a landfill site. But unlike the Kilcona landfill, this landfill developed without thought to its future land use once its capacity had been attained. Sky Mound is located at the Hackensack Meadowlands in northern New Jersey. In its completed form it now stands 33 metres high and contains 10 million tons of garbage. Because of its prominence in the landscape, and because it could form a hub for a network of similar reclaimed landscapes located throughout the region, a redevelopment of the site was considered (Beardsley, 1989). Its context consists of various light industries, from which it is physically separated by railway lines and an interstate highway.

The 25 hectare site reclaims land for public use, and through a solar, lunar and stellar observatory, attempts to contrast the chaotic industrial environment with planetary dynamics. The standard technology used to attain closure of the landfill was capitalized on as an opportunity and became part of the park experience. Pathways double as the surface water drainage system and metal arches defining the stellar observatory serve as a methane gas recovery system. The primary vegetation of the site is grass chosen so as to not interfere with the integrity of the landfill's cap (LeVeque, 1985).

In general, Nancy Holt has continued the tradition of Robert Smithson by creating works that are characteristically remote, large scale and durable. Most significantly, she carries on with Smithson's interests of working with sites heavily disturbed by past land use. Holt also believes that art needs to be functional if it is to have the greatest impact on society. Like many environmental artists, Holt feels that humans have lost some balance because of the constant changes in society as a result of

Top: An aerial view of Sky Mound by Nancy Holt shows the industrial land use context of the project. Source: Earthworks and Beyond, *1989.*

Bottom: The plan of Sky Mound shows the development of view lines off the site that are based on solar and lunar observation. Source: Earthworks and Beyond, *1989.*



technological advancements and that humankind needs consistency and stability to achieve orientation. As a result of her positions, a new relationship between humans and nature is sought in her work (Sonfist, 1983).

2.5.3 Spiral Jetty

Robert Smithson, in his writing and projects, focused on the reclamation of sites heavily disturbed by past land use. He was preoccupied with entropy as a measure of disorder and how humans contribute to inevitable entropic change. He saw his works as an acknowledgement of, and alternative to, this process (Beardsley, 1979). Smithson also wrote about his perception of industrial activities. He did not entirely detest industrial activities, recognizing them as a necessary corollary of the life we have developed for ourselves. He viewed human interventions in the landscape as

Shown is an aerial view of Spiral Jetty located in the Great Salt Lake, Utah, by Robert Smithson. Source: Probing the Earth, *1989.*

no more unnatural than earthquakes and typhoons. What he did take exception to, however, was the lack of sensitivity he perceived among industrialists to the visual values of the landscape, which he felt were; "*traditionally the domain of the those concerned with the arts.*" He went on to state that "*art can become a physical resource that mediates between the ecologist and the industrialist facilitating the aims of both*" (Beardsley, 1989).

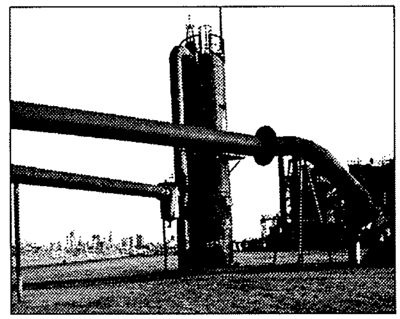
Smithson's best know project, Spiral Jetty, is located on the northeastern shore of the Great Salt Lake in Utah near an old industrial site where efforts were developed to extract oil from tar deposits. His recordings that describe the events that lead him to the site are quite explicit of his nearly romanticized notions of this deserted industrial area. Smithson's intentions were never to camouflage, ignore or hide the history and desolation of the place but rather to draw attention, or focus onto it. He was realistic in his designs, almost commemorative of these post-industrial areas (Sonfist, 1983).

As with most earthwork projects there is a strong correspondence between the work and the site. Spiral Jetty, 500 metres in length, constructed from indigenous materials such as, black basalt, limestone rocks and earth, curls into the lake which is enclosed by the roundness of the shore. Smithson endeavours to express the duality between nature's ability to create and destroy, and therefore he used a dynamic and irreversible form as the expression. He described the character of the peninsula and the lake bottom as a; "*shattered appearance, a dormant earthquake spread into fluttering stillness into a spinning sensation without movement* "(Smithson, 1979). From this place emerged the Spiral Jetty, an open, irreversible form that echoes the molecular lattice of the salt crystals that coat the rocks, and the mythical underground channel which reveals itself in the middle of the lake as an enormous spiralling whirlpool. This mass extends out into the pinkish lake, but reaches no point, it goes nowhere (Beardsley, 1989). Spiral Jetty is successful because it is intimately linked to its site. Through the linkage, Spiral Jetty addresses issues of contemporary culture's relationship with the land, rather than ignoring them by attempting to sweep them aside. This act has resulted in provocative and meaningful experiences for those fortunate to have visited the site.

2.6 Gas Works Park, Seattle, Washington

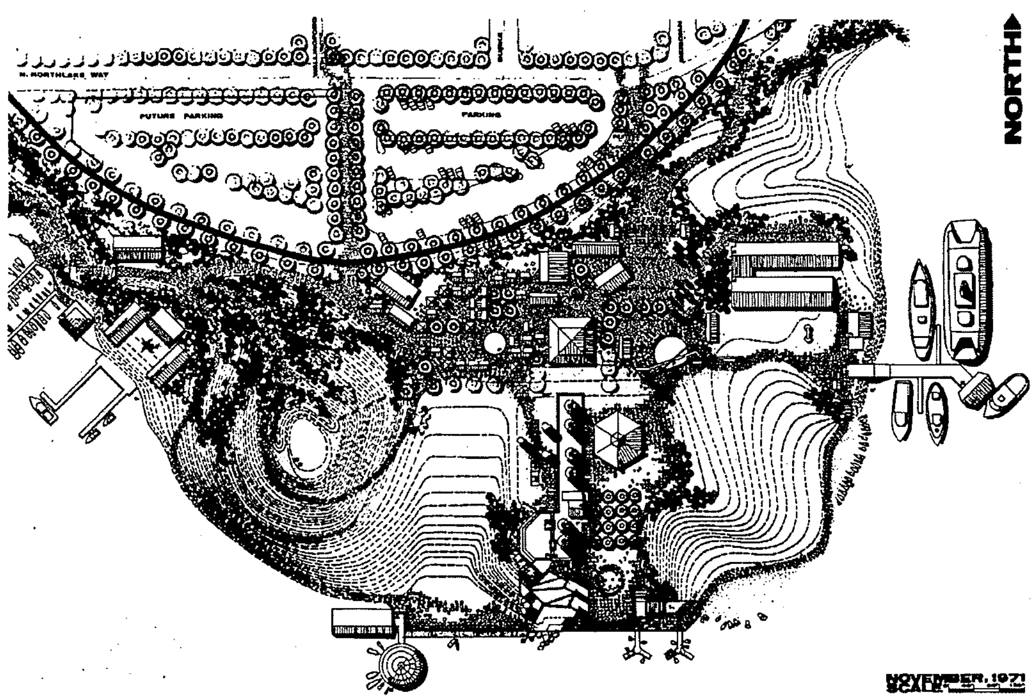
Gas Works Park in Seattle is a highly relevant precedent in the examination of the Transcona Domtar site. A strong connection can be forged because of their similar sizes, and their long history of industrial use which has resulted in significant soil contamination. Soil contamination at Gas Works has constrained land use options, the range of vegetation that could be used as part of the development and has even closed the park for a period of time.

The function of the plant had been to separate gas from coal. This activity continued from 1906 until 1952 when the process was rendered obsolete by a high pressure gas pipe line brought into the city. The site was originally slated to become a traditional park focused on passive recreation with groves of trees and large areas of lawn. However the park was developed it would be the only public open space on the shore of Lake Union at the time. For several reasons the more traditional design solution was abandoned. This was due to the significantly contaminated soil and leftover concrete foundations and piping. Seattle also had a significant collection of traditional parks elsewhere so there was little demand for another even in this unique location (Campbell, 1973).



Above: A detail of Gas Works Park by Richard Haag showing the character of the remnant industrial structures and their relationship to the city skyline. Source: Modern Landscape Architecture, *1991.*

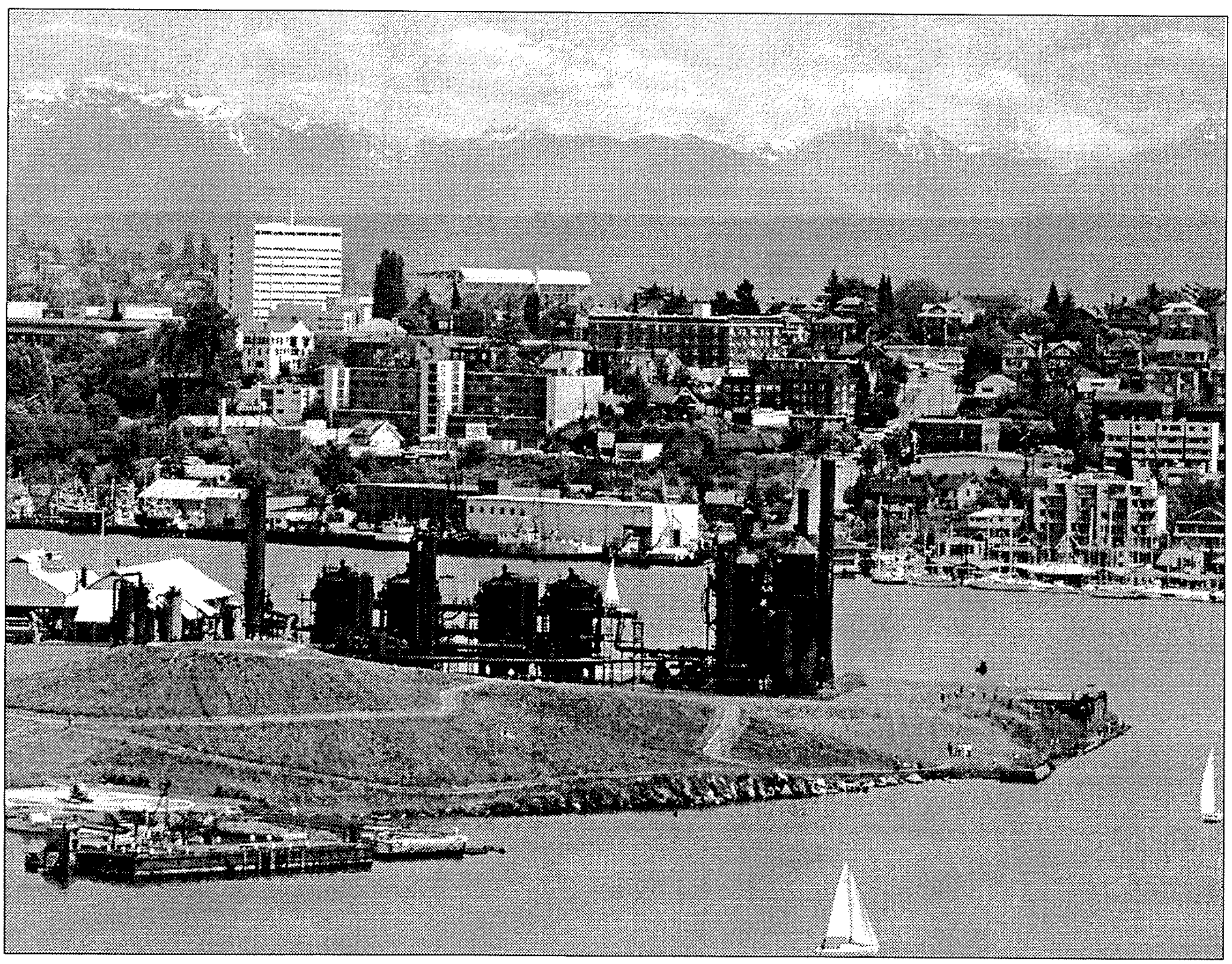
Right: The plan of Gas Works Park as prepared in 1973. Source: Landscape Architecture, *January 1985.*



Richard Haag was commissioned to prepare a master plan for the park in 1970, three years prior to the final purchase of the land by the city of Seattle. By 1971, Haag had proposed a master plan that proposed that portions of the structures on the site be retained for their sculptural qualities and their potential as landmarks and delineators of the space of the park. More than a year was spent in gaining acceptance for his proposals and addressing fears that the site would be nothing more than an eyesore on the city's waterfront. During this time input was also solicited from the community surrounding the future park site (Johnson, 1991).

The soil contamination was initially addressed using experiments in bioremediation, but some areas proved so toxic that material was capped under thick layers of fill material or was trucked off the site. As a result of the capping process, large elementary earth forms were developed. These forms, such as the Great Mound, were used to organize the site's program.

Shown is an aerial view of Gas Works Park by Richard Haag. Source: Modern Landscape Architecture, *1991.*



The layout of space supports flexibility of activities from informal games to temporary events like concerts and political rallies. The response taken with the remnant industrial forms and buildings was one of adaptive reuse rather than museumification. They are recycled to support new activities and are celebrated for what they are and can be, rather than what they were (Johnson, 1991). The sun dial on top of the great mound contributes to the park's focus on the present. The reference to solar events through the sundial can be seen in parallel to the earthwork projects, specifically Sky Mound.

2.7 Conclusions

Three general design responses can be identified from the precedents presented. First is the involvement of the community surrounding the site. As demonstrated by several of the precedents, the process of involving the community has included the gathering of information on site perceptions as well as the sharing of information concerning both remediation and redevelopment activities that are proposed for the site. Community involvement can also occur by involving the public directly in the construction of the design. Many conceptual artists who work in the landscape, including Smithson, have stated that the process of generating interest in the community, raising money to complete the project, obtaining the necessary permits from the various governing bodies, and then finally constructing the project, is as important, if not more important, than the final product that comes out of the process (Fleming, 1986).

The second design response observed in this study was the focus on active recreation. Gas Works Park is a good example of this trend primarily through its use of loosely programmed spaces that support a range of activities. The program of Gas Works Park is also centred around children and their preferred modes of play. In the case of both Fort Whyte and Wildlands Park, the focus is on the creation of habitats and the primary activities have become environmental interpretation including a wide range of activities designed for children.

The third design response that can be used with the redevelopment of sites disturbed by past land use is represented by the earthwork projects. The earthwork projects contrast the responses of the projects designed by landscape architects because the artists do not develop a client driven program of activities. While the landscape architectural and artistic approaches each involve the communication of ideas and the creation of meaning, the earthwork projects focus on the application of purely theoretical ideas and do not deal with more practical and pragmatic concerns. The earthwork artists endeavour to present a dialogue on the interaction of humankind, culture and nature by focusing attention on the site, its context and past land use. In contrast, the Clarkson Refinery project uses redevelopment as a way to buffer conflicting land uses and improve the value of adjacent land. Gas Works Park, on the other hand, embodies a synthesis of the sculptural and architectural responses. Parts of the original industrial facility are kept, which results in the generation of a dialogue similar to that embodied within the earthwork projects, while the provision of amenity has increased the value of the site. Another similarity between the sculptures and Gas Works Park is that each type incorporates elemental earth forms to order space. In the case of the sculptors, highly dynamic earth forms were used to address natural forces such as entropy. In the case of Gas Works Park, the dynamism inherent in the design originates not so much from the earth forms themselves, but from the programmed activities that are defined and organized by them.

The design responses identified from the precedents have helped to define areas of emphasis within the site analysis. Analysis, undertaken with surveys of adults and children, has generated insight into residents' current perceptions and use patterns regarding the Transcona Domtar site. Additionally, the analysis of land use, both past industrial, and current remedial and recreational, has received emphasis. An understanding of former land use is important because a link between the site's past and present land use activities, using an interpretive component, can be established. A link of this nature would begin a meaningful process of healing negative perceptions. The possibility of using the site's soil as a medium for artistic expression has lead to an examination of its characteristics as a building material.

3

Analysis

Analysis of the Transcona Domtar site has identified a series of design implications that have been used to formulate a site design. Typical areas of analysis common to most practica are included in this chapter, but in addition, several unique areas of analysis resulting from the site's heavily disturbed and contaminated condition have also been included. A community survey, as well as sections such as those addressing the operations of the wood preserving plant, the nature of the contaminants, the extent of contamination, the risk assessment results, and the remediation strategies undertaken thus far, all make up the less typical components of analysis in this study.

3.1 Land Use Patterns

The analysis of land use patterns will focus on the processes used to preserve wood and the processes used to remediate the contamination. The remainder of the section will focus on use patterns of the residents from the

Title page: A view west along the Canadian National Railway tracks. Source: H. G. Brumpton, 1996.

community observed on the site, together with some discussion on activities prior to the treatment plant's operation. Consideration of the extent of impact on the site, the remediation strategy presented to the public in June of 1996, and the risk assessment, will be undertaken with the intent that the design proposal will be informed by this analysis.

3.1.1 Land Use Patterns Prior to the Wood Treatment Plant

From the airphoto taken in 1968, it can be observed that farmland borders the site on the west and north sides. Prior to the development of the wood treatment facilities, it has been assumed that the land was used for agricultural activities. Understanding the site's history is important to broaden any interpretive activities that could be proposed. The presentation of a broad perspective on the history of this site is essential as it will allow for an acceptance and possibly even an appreciation of the site to be developed. Components of the site's history that occurred prior to the wood treatment activities that would be suitable for interpretation include events since the last ice age like the development of Lake Agassiz and the prairie ecosystem.

3.1.2 Wood Treatment Plant Operations

The Transcona site was selected for a wood treatment plant prior to 1909 because of its strategic geographic location and proximity to both the Canadian Pacific and Canadian National rail lines (MacPlan, 1992). The plant was operational for a total of 65 years from 1911 until 1976.

The wood preserving plant's main function was to provide railway ties and other heavy timber for the Canadian Pacific and Canadian National Railways. Beginning in the first year of its operation, the plant produced 125 000 railway ties and from thereafter maintained an annual production of approximately one million. During the late 1950's the plant's product mix changed in response to consumer demand. Utility poles, fence posts, foundation pylons and other timber products began to be produced. At its peak, the plant produced up to 80 000 utility poles per year (MacPlan, 1992).

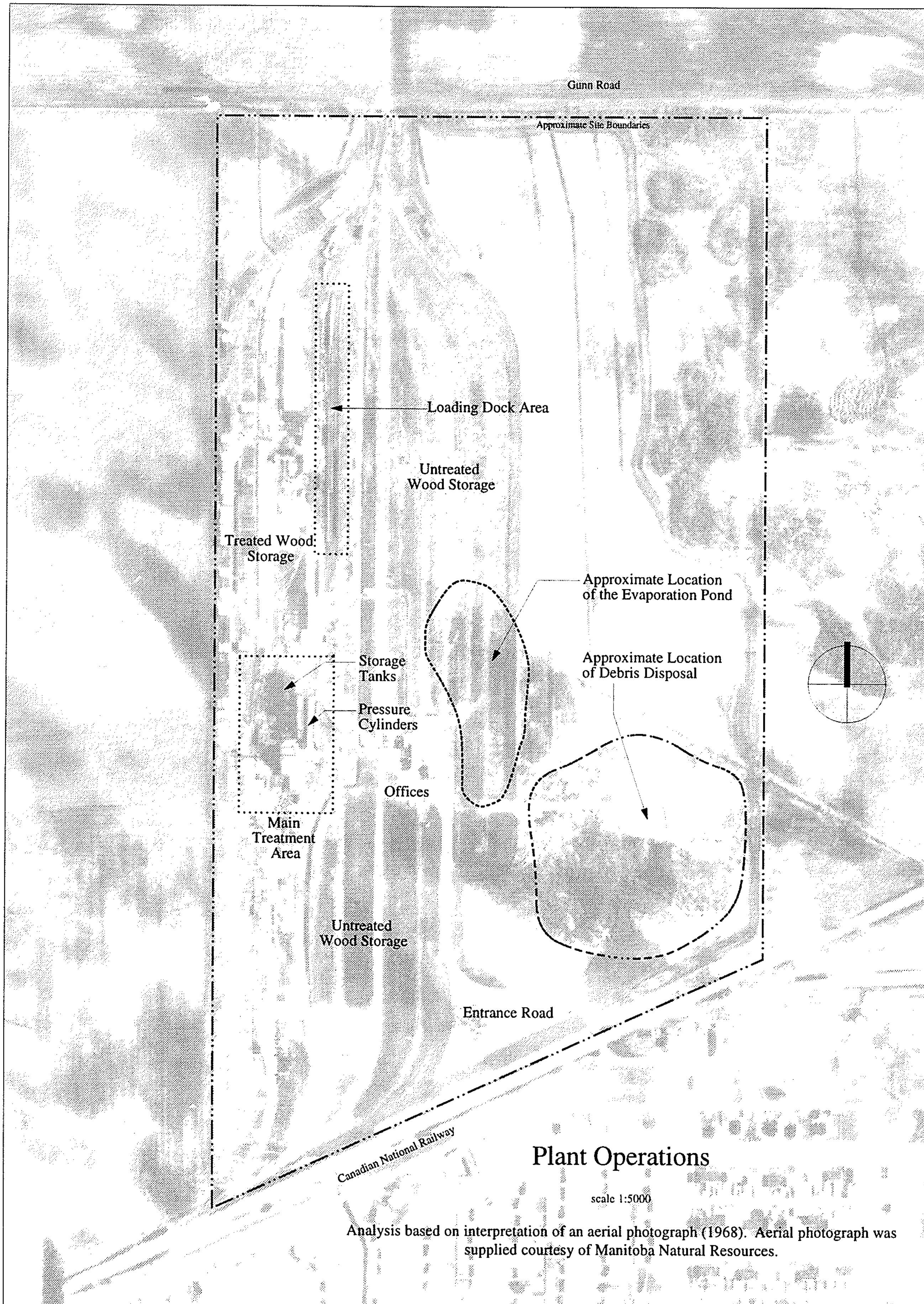
For the first 40 years of operation, until 1951, the plant only used creosote and creosote solutions for wood treatment. Because creosote treated wood is black, oily, and as a result difficult to handle, the market began to demand cleaner products. As a result of these market changes, the plant started to use pentachlorophenol (PCP) as a treatment solution for utility poles in 1952 (MacPlan, 1992). Wood treated with this material is usually light brown in colour and weathers to a gray. The use of creosote continued at the plant for heavy timbers and railroad ties.

The two wood preservative chemicals used at the Transcona Domtar site each have unique characteristics. Creosote is considered one of the first truly effective wood preserving chemicals. Its use started in this type of industry around 1840. It has been estimated that 15.75 million litres of creosote were used per year at the Transcona Domtar site (MacPlan, 1992). Creosote is a mixture of more than 200 compounds, with the majority of the common compounds being polyaromatic hydrocarbons (PAH). Creosote is a dark brown oily liquid and consists principally of liquid and solid aromatic hydrocarbons. It is heavier than water. The complicating factor in the composition of creosote is that the amount of the various parts can vary widely depending on its source.

The second type of wood preservative used at the Transcona site is called pentachlorophenol (PCP). The first use of PCP as a wood preservative occurred in 1936 (Richardson, 1978). PCP is not a natural compound, and as such, it should not be found in the environment. At low concentrations, PCP is not considered a persistent contaminant in the environment because of documented photochemical degradation and microbial breakdown in surface waters, soil media, and sewage effluents (MacPlan, 1992). However, PCP is widespread at low concentrations in the environment, even in remote locations, indicating that the above conclusions are not universal, or that input rates exceed those of degradation. For a more detailed discussion of each chemical see Appendix A.

Wood treatment is defined as the pressure or thermal impregnation of chemicals into wood to a depth that will provide effective long term resistance to attack by fungi, insects, and marine borers. The environmental consultants' document on the Transcona site goes on to state that by extending the service life of available timber, wood treatment reduces the harvest of already stressed forestry resources, diminishing operating costs in industries such as utilities and railroads, and ensures safe working conditions where timbers are used as support structures (MacPlan, 1992). This notion is also expressed by Richardson in his book entitled *Wood Preservation* (Richardson, 1978).

The wood treatment process generally consisted of four stages. First the wood was prepared by peeling off the bark, then it was machined into



Plant Operations

scale 1:5000

Analysis based on interpretation of an aerial photograph (1968). Aerial photograph was supplied courtesy of Manitoba Natural Resources.

the final product and then it was air dried. After the initial preparation of the wood, the chemicals were applied to complete the process. To apply the chemicals, the wood was loaded onto trains which were positioned inside a treatment cylinder. These cylinders ranged in diameter between 2.1 to 2.4 metres and in length from 15 to 50 metres. The wood was loaded and sealed into the cylinders and their interiors were pressurized. The full cell and empty cell processes were used introducing the preservatives to the wood on the Transcona site (MacPlan, 1992). The steps of these processes can be found within Appendix B. Once the desired amount of chemicals had entered the cells of the wood, the wood was placed under vacuum pressure to remove excess preservative.

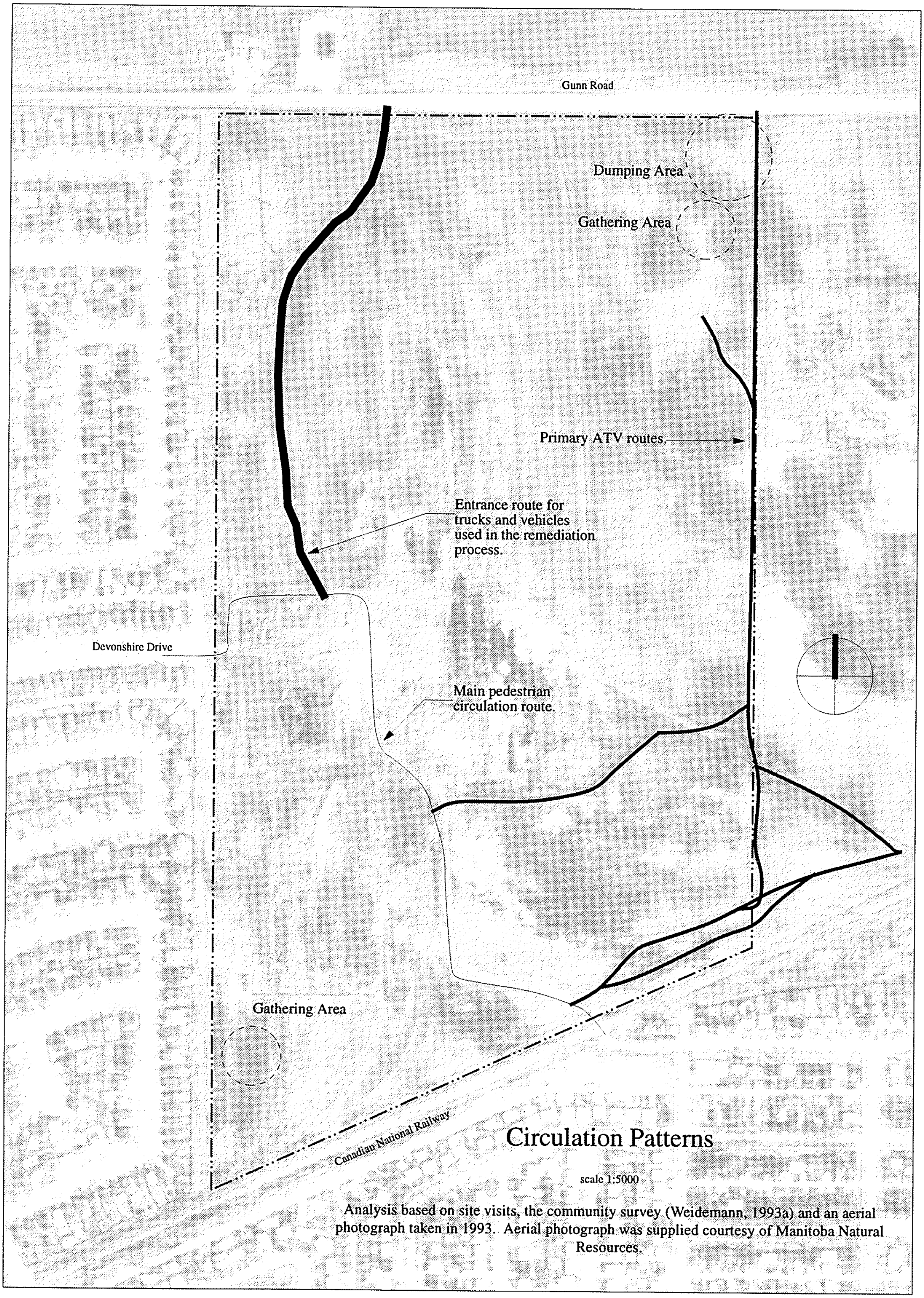
Effluent discharge as a result of wood treatment at this site ranged considerably. The consolation provided in the baseline environmental risk assessment prepared in 1993 is that wood preserving plants produce a relatively small volume of liquid waste in comparison with other unnamed industries (MacPlan, 1992). Effluent discharge ranged from 4500 to 45 000 litres per day. Annual average discharges where approximately 9000 litres per day. In 1969 with the installation of the evaporation pond, effluent discharge fell to between 900 and 2250 litres per day (MacPlan, 1992). The pond's dimensions were 90 meters by 12 meters and 1.2 meters deep. The installation of the evaporation pond came as a result of the Provincial and Municipal Authorities notifying Domtar that its prior discharge technique was unacceptable. Domtar had been discharging effluent into the Cordite Ditch via a second ditch that ran the length of the west side of the site (MacPlan, 1992). The drop in total discharge after the building of the pond shows that once the waste materials had to be dealt with on site, less material was generated.

Facing: A diagram of the wood preservation plant operations in 1968. Sources: an aerial photograph supplied courtesy of Manitoba Natural Resources and the Environmental consultants' reports (MacPlan, 1992 and UMA, 1996).

After almost fifty years of continuous operation, a decline in product markets resulted in the introduction of seasonal operation (7 to 8 months per year) in 1960. In the 1970's after continued market decline it became harder to justify the continued operation at the site, and as a result, the plant was shut down in 1976.

Design Implications

It is important that residents and others alike have the opportunity to confront the historical dimensions of the site if they so chose. Through a design proposal that addresses the historical dimension of this site, opportu-


Gunn Road
Dumping Area
Gathering Area
Primary ATV routes
Entrance route for trucks and vehicles used in the remediation process.
Devonshire Drive
Main pedestrian circulation route.
Gathering Area
Canadian National Railway
Circulation Patterns
scale 1:5000
Analysis based on site visits, the community survey (Weidemann, 1993a) and an aerial photograph taken in 1993. Aerial photograph was supplied courtesy of Manitoba Natural Resources.

nities arise to learn from the mistakes of the past and deal more constructively with similar situations in the future.

3.1.3 Land Use Patterns by the Public

There are well-travelled pedestrian and all-terrain vehicle routes through and around the site. These routes include primarily the old internal service roads. Children and teens often use open fields and paths to access the more heavily vegetated areas of the site. Information concerning the activities of children on the site was collected from site visits as well as from the community survey questionnaire that is discussed in section 3.3 of this practicum (Weidemann, 1993a).

From the survey it was also ascertained that some children and teens use various bush areas on the site, especially the edges and clearings within them, to '*play*', '*loiter*', and '*party*'. In several areas of the site it is obvious that children had used the sites as gathering points. Some adults indicated that they use the land around the fenced-in area and the major pathways for relaxation, recreation, and passing through. Some respondents to the adult survey also indicated that they avoid the fenced-in area, the soil-tilling field, and places that are too wet. There is also evidence that a homeless person has lived on the site for a period of time during the summer months.

Design Implications

The strong patterns of use have been observed on the site and were expressed through the questionnaire. Even given its ambiguously contami-

Facing: A plan diagram showing the patterns of use on the Transcona Domtar site by the public. Sources: site visits by the author, the community surveys (Weidemann, 1993b) and an aerial photograph supplied courtesy of Manitoba Natural Resources.

Left: A view of a gathering area in the northeastern portion of the site. Source: H. G. Brumpton, 1996.

nated state, the amount of use that the site receives demonstrates its need for redevelopment. Circulation between the surrounding neighbourhoods is a central opportunity that will be addressed by the design proposal. Facilitating youth-oriented activities is another potential that the current use patterns suggest could be successful in implementation.

3.1.4 Remediation Activities

Remediation activities have been a critical part of the land use history on the Transcona Domtar site. In examining the remediation activities that have been occurring on the site, past remediation activities, as well as those most recently proposed by Domtar, have been considered. As well, the risk analysis will also be examined as part of the analysis of the remediation activities that have been undertaken on the Transcona Domtar site. A chronology of remediation activities has been compiled in Appendix D.

3.1.4.1 Past Remediation Activities

Soil sampling began in 1976 and the first remedial plan was prepared by MacLaren Limited Environmental Consultants in 1977. Since the wood treatment plant's closure, Domtar has conducted interim rehabilitation of the site that includes: removing all debris and physical hazards from the site; removing hot spots of surface soil contamination; installing a security fence around the former treatment area; disking and tilling the soil in the north and south storage areas; draining and backfilling of the former evaporation ponds; and abandoning and capping of the storm water drainage wells (UMA, 1996).

In 1993 a thermal phase separation system was chosen as a remedial strategy and in 1994 it was installed on the site. This form of remediation technology consists of contaminant extractions by heat induced volatilization from a contaminated medium at a suitable temperature which avoids premature breakdown of the compound. On the Transcona Domtar site this technology failed as the "*difficulty in the handling and processing of the clay soil was the main reason the separation process was unsuccessful. Clay soil is a problem for most remedial technologies...*" (UMA, 1996). The UMA report goes on to state that complaints were also made by the residents living nearby regarding odour emissions from the thermal phase separation system demonstration project.

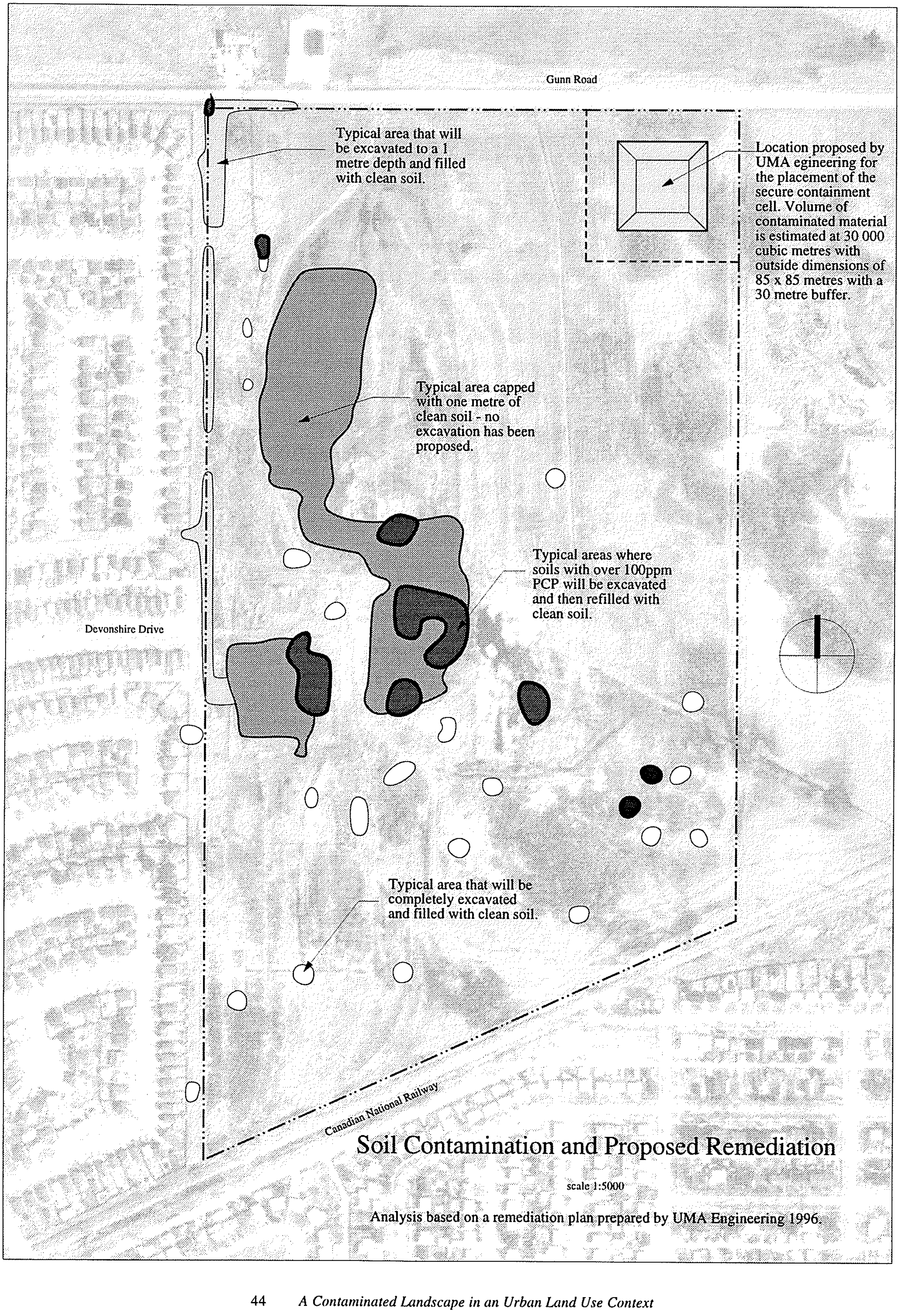
Design Implications

The failure and controversy of previous remediation attempts has left the residents who are concerned about activities on the site disillusioned and frustrated. This condition was made obvious during the community meeting held in June of 1996. It seems that the ambiguity currently surrounding the future land use options is a very large concern for the residents. An overall criticism of Domtar's proposal was provided by Dr. Yassi of the Occupational and Environmental Health Unit of the University of Manitoba. In her critique of the proposal, she states "*we were indeed disappointed that this issue (future land use) has not been more fully discussed in the documentation, given the long struggle surrounding this Domtar site.*" (Yassi, 1996). The resources that have been put toward exploring future land use options for the Transcona Domtar site have been insufficient given the level of concern expressed by the community.

3.1.4.2 Proposed Remediation Activities

The current remediation proposal has been developed by UMA Engineering for Domtar (UMA, 1996). Several remedial alternatives were evaluated in their report for applicability to the conditions of the Transcona Domtar site. As well, a brief overview of end use development, on sites which involve similar remediation strategies, were presented as case histories. Domtar's remediation objectives are to reduce the potential risk to current and future users of the site. Their objectives also state an interest in developing the site for a future beneficial use. To maximize the beneficial use of the site in the future, development will be allowed that is compatible with the remedial strategy. The report lists land use options like green space and possibly commercial or light industrial facilities (UMA, 1996).

The plan presented by Domtar for the remediation of the Transcona site involves the use of technology which has been proven to be effective for the types of soils present at the site and that Domtar can apply with confidence such that the remedial objectives of risk reduction and beneficial future use can be met within a reasonable time frame (UMA, 1996). The proposed remedial plan developed by Domtar includes six components. The first is the construction of a secure containment cell in the northeast corner of the property. The soil will be encapsulated in a cell that incorporates: a cover liner which will under normal circumstances reduce to neg-



Soil Contamination and Proposed Remediation

scale 1:5000

Analysis based on a remediation plan prepared by UMA Engineering 1996.

ligible the volume of precipitation that could predictably enter the system; a base liner system beneath the impacted soil that will contain, intercept and allow for the removal of any leachate before that leachate can escape the environment should it penetrate the cover liner; and a monitoring system that will ensure the integrity and long term performance of the system. According to report, the engineering of the cell is based on US EPA guidelines for hazardous waste landfills and incorporates some of the best technology and concepts currently available. The report goes on to state that this proposed landfill technology has been successfully implemented in thousands of applications throughout the world, including similar hydrogeologic and climatic conditions as found on the Transcona site (UMA 1996).

The dimensions of the cell will vary to some extent based on the volume of material that will need secure containment. At present, the UMA report estimates the volume of material to be placed in the cell to be 30 000 cubic metres. With this volume the cell will have a footprint of 85 by 85 metres and a below grade depth of 5.5 metres. Height above grade has been estimated at 3.5 metres. It has been stated in the report that this dimension will minimize the visual and aesthetic impact of the containment cell (UMA, 1996). The decision to minimize the visual impact of the cell was based on input received by the residents' representative.

The excavation and placement of the polluted soil into the secure containment cell is the next step in the remedial proposal. Soil that is proposed to be placed in the cell includes: all highly polluted soil containing PCP at concentrations above 100 ppm; all isolated pockets of soil impacted above the site specific risk assessment residential/parkland criteria located primarily in the south of the former main plant area; and the upper one metre of impacted soil from the south site drainage ditches located along Bellavance and Gunn Roads which exceeds the site specific risk assessment residential/parkland criteria.

Facing: A plan diagram that shows the locations of contamination in 1995 and the remediation work proposed by UMA Environmental. Sources: UMA, 1996 with the aerial photograph supplied courtesy of Manitoba Natural Resources.

In concert with the excavation, the remediation plan proposes that all excavated areas will be backfilled to appropriate elevations with a clean low permeability fill such as clay soil. An engineered cap placed over the former main plant area, and the treated lumber area and evaporation pond areas will be developed. Development of the cap does not involve excavation of contaminated soil. Excavation has been avoided to reduce the risk of generating dust emissions that could contain hazardous levels of contamination. The cap will result in a hill which outlines the contaminated areas, that will be at least one metre in elevation, being generated on the site.

The next step in the remedial proposal is the development of appropriate long term plans for the site which would include: a health and safety plan; a post closure operations, maintenance and monitoring plan; contingency plans; a storm water management plan; and a plan for financial guarantees. The report lists as the final step the development of appropriate beneficial end use for the site that will provide long term risk management. As part of this final step, legal and land use restrictions will be implemented to ensure that future activities and land use remain protective of human health and the environment.

Design Implications

The most recent remediation proposal has come nearly full circle from the initial proposals presented over a decade ago, returning to capping and secure containment of the soil on site. There are three components of the current proposal which have been identified as generating design implications. These are the implications regarding the areas that are proposed to be capped with soil, the secure containment cell placement and dimensions, and the long term monitoring and maintenance that will occur on the site.

Design implications arising from the capped areas revolve around protecting the integrity of the cap. As will be discussed in the following section, the risk analysis prepared as part of the remediation proposal has concluded that separation of receptors from the contaminated soil will reduce risk at the site to acceptable levels. Therefore, construction of buildings on the site will have to be undertaken in such a way as to avoid penetrating the cap for foundations or services. Choice of plant material for the cap is also worth consideration as plants whose roots would penetrate the cap would work against the remediation efforts and increase risk. It should be noted, that approximately three quarters of the site will not have this level of constraint inherent to it. Development proposals for the areas that will not be contaminated subsequent to remediation could conceivably be limited only by municipal zoning regulations. Finally, in addition to the importance surrounding the protection of the integrity of the cap, the areas to be capped will generate earth forms on the site that are of an unusual and obvious shape. This analysis does not find that the concept desired by the residents' representative, that of out of sight out of mind, will be successful given the current proposal.

The next element of the remediation proposal which generated design implications is the secure containment cell. Two implications have been identified: first, addressing the placement of the cell on the site and secondly, its dimensions. The cell could become an interesting feature on the landscape, used to facilitate a number of recreation pursuits such as tobogganing. Unfortunately, because of the lack of significant topography in and around the site, any earth form developed with the secure containment cell will be visually and aesthetically prominent in the landscape. As such, the cell would become a permanent monument of the contamination. The residents' representative has stated the desire to avoid having the cell become such a feature; therefore, minimizing the vertical dimensions of the cell would seem to be advantageous. Additionally, the placement of the cell in the northeast section of the site, while responding to some concern in the community about its visual and aesthetic impact, will impact an area of previously undisturbed aspen parkland forest. Other areas of the site could be more appropriate for placement of the cell in order to preserve existing ecological resources.

The remediation proposal indicates that money is to be made available for long term monitoring and maintenance of the remediation works on this site. The perpetual financial commitment to the site that will be required for the remediation proposals to be successful could be brought to encompass maintenance of the land use development that would take place on the Transcona Domtar site.

3.1.4.3 Risk Assessment

As part of the remediation process selection procedures in the various reports prepared to date, several risk assessments have been undertaken and elaborated on by the various environmental consultants involved. A risk assessment is an evaluation of potential consequences to humans, wildlife, or the environment caused by a process, product, or activity, and including both the likelihood and the effects of an event (Graedel, 1995).

A preliminary risk assessment was prepared by MacPlan Environmental Services in 1992 for the Transcona Domtar site. This initial assessment has been updated by Environmental Strategies Corporation to reflect the monitoring data collected during 1995 and 1996 (UMA, 1996). The results of this most recent risk assessment show that local residents in off site areas do not have any human health risks from chemicals at the site. Local residents do not use ground water as a domestic supply and no significant quantities of chemicals are leaving the site in the soil or as air emissions. The results of the risk assessment also show that the only risk to human health is from on site activities which involve contact with exposed impacted soil. However, the risk assessment goes on to state that the risk is only significant if very conservative assumptions are made regarding duration and magnitude of exposure. The proposal that is put forth as part of the risk assessment is that risk can be controlled by installing a competent barrier system between receptors and the contamination, and by implementing appropriate health and safety measures should subsurface excavation work be required in impacted areas (UMA, 1996). This system would prevent contact with the impacted soil that could occur during normal site activities.

The risk assessment also concluded that human health risk to on site construction workers, and to a lesser degree the residents in off site areas, could potentially result during excavation of impacted soil. These risks could be controlled by conducting excavation work in a controlled manner, following appropriate engineering and safety practices to reduce the dust created during excavation which would result in uncontrolled release of chemicals to the air. By moving soil, risk will be generated principally for the remediation workers (UMA, 1996). This is the reasoning behind minimizing the areas to be excavated in the remediation proposal.

Design Implications

There are two design implications that have arisen from the risk analysis. The first is a reiteration of the importance of maintaining the integrity of the cap that will be applied to the less impacted soils on the site, as well as the top cap of the secure containment cell. Each of these engineered earth works must be protected from penetration of the cap from subsequent construction activities. Additionally, as part of the remediation process, the excavation of soil will generate risk. The manipulation of contaminated soil, in excess of the volumes prescribed in Domtar's most recent remediation proposal, will be complicated and limited by the risk involved.

3.1.5 Summary of Design Implications

Several design implications were identified from the analysis of the land use patterns on the Transcona Domtar site. From the operations of the plant, it is important to address historical dimensions of the site in order that the mistakes made can be teaching tools. As well, the analysis of the use patterns has shown that, in addition to the remediation activities, a significant amount of use is occurring on the site. This use is principally by adults using the paths around the site for walking, and children and young adults using parts of the site as gathering areas. The land use design implications identified from past and proposed remediation activities focused on the time taken for remediation to be undertaken. Avoiding the disturbance of the cap and secure containment cell was also identified as an important design implication. Finally, the inadequacy of the land use proposals, especially given the importance placed on this issue by the community, was the final design implication identified.

3.2 Context

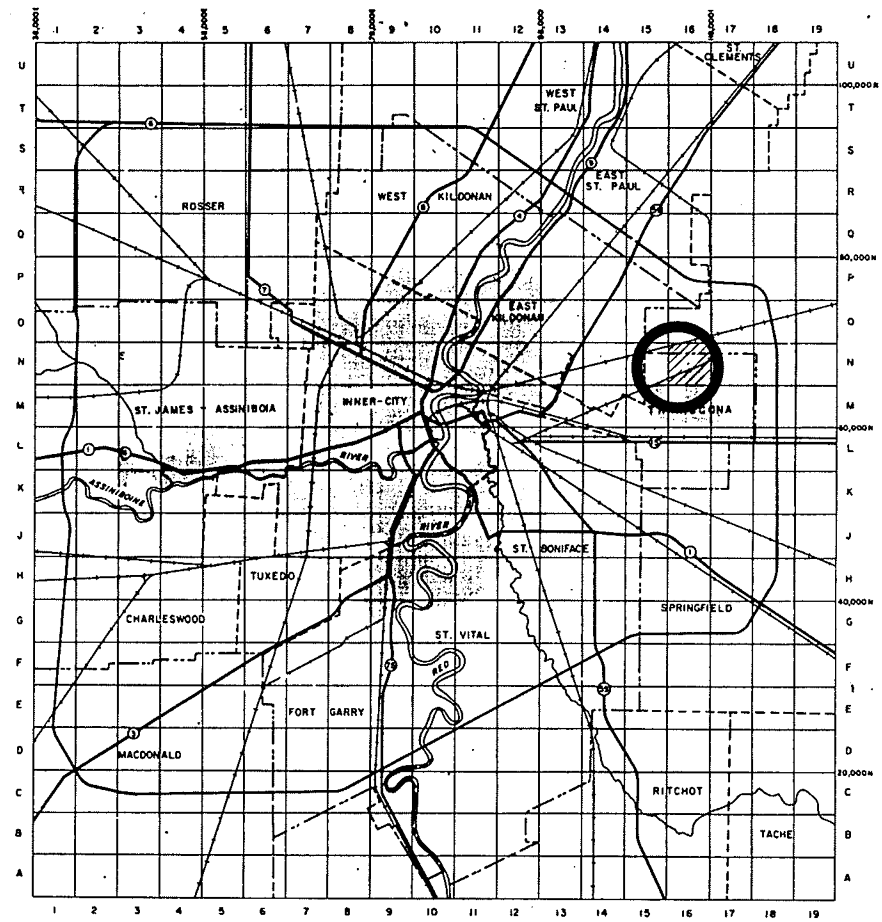
Issues that can be derived from a site's context are those that may be applying pressure onto the site from outside its boundaries. The examination of the Transcona Domtar site's context involved researching three general areas of information. The site's location and size; the land use patterns observed on adjacent landholdings as well as throughout the community; and an examination of the site's boundary characteristics, all comprise the general areas of inquiry within this section of the inventory and analysis.

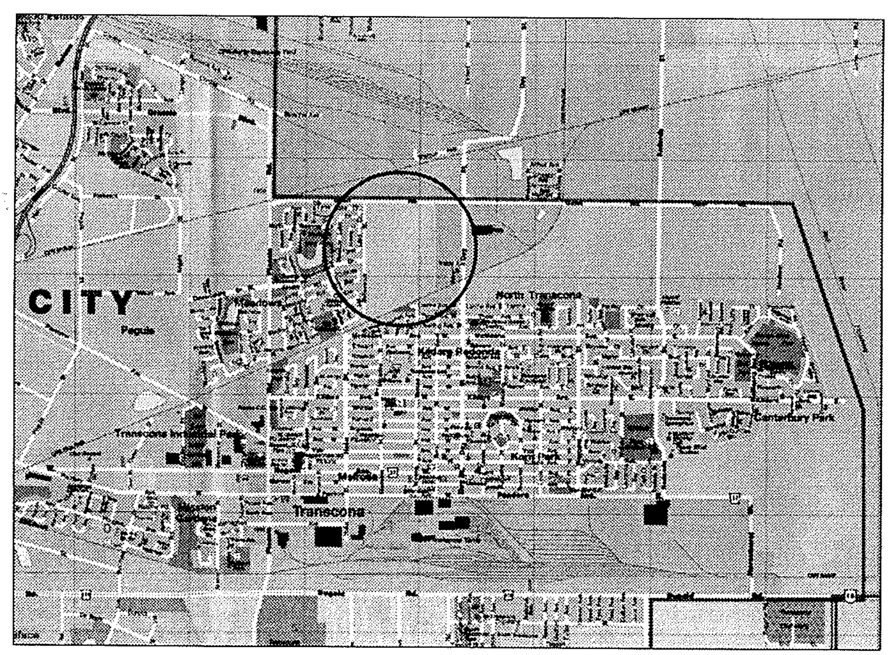
3.2.1 Site Location

The site is owned by Domtar Chemicals Limited, which will be henceforth referred to simply as Domtar. This site currently forms part of the north boundary of the neighbourhood of Transcona in Winnipeg, Manitoba. The Transcona Domtar site is located within the city limits of Winnipeg but borders on the Municipality of Springfield whose jurisdiction begins on the north side of Gunn Road. The site is 45 hectares in size and is approximately 16 kilometres east of the downtown core of Winnipeg. Transcona is an area of Winnipeg with well defined boundaries, due mainly to a series of rail yards to the north and south, and to the Red River floodway which defines its eastern edge. The rail industry was the initial force behind the community's development and traditionally provided the majority of employment.

A map of the City of Winnipeg showing the location of the Transcona Domtar site. Source: the City of Winnipeg, 1972.

Top: A map showing the location of the Domtar site relative to the community of Transcona. Source: Map Art, 1995.





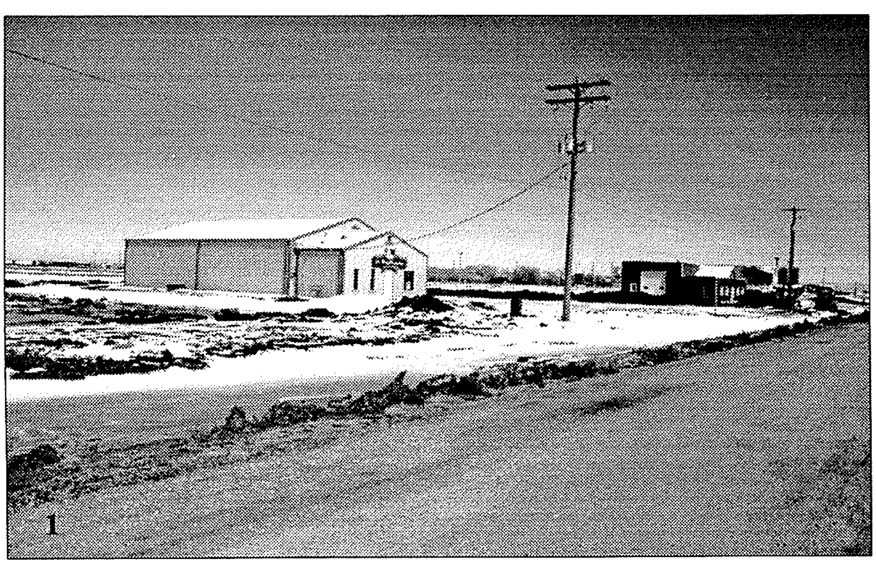
3.2.2 Adjacent Land Use Patterns

The areas adjacent to the Transcona Domtar site have varied uses and zoning designations. To the north of the site, within the jurisdiction of the Municipality of Springfield, there has been recent development of light industries like carpentry and machine shops. Most of this development is visible from the north section of the site. More attractive tax rates and the relative proximity of city services and markets are probably the motivation behind this type of development.

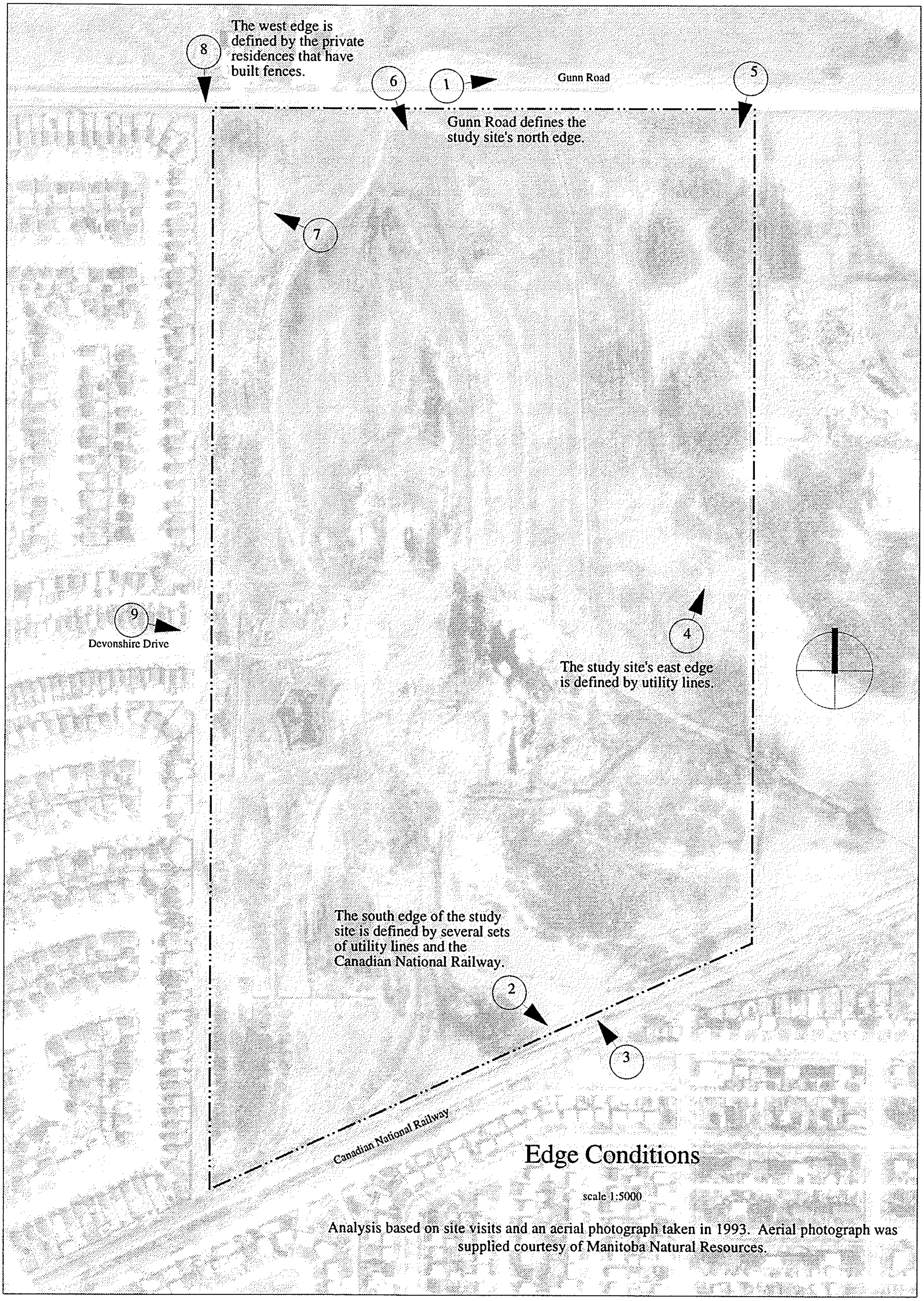
To the east there are three industrial sites bordering the Transcona Domtar site. The developed portion of the largest of these industrial sites borders the Domtar site directly. From an airphoto taken in 1993, it can be interpreted that the portion of this particular neighbouring site closest to the Transcona Domtar site is used primarily for storage and is fenced. The other of the adjacent sites are buffered from the edge of the Domtar site by a stand of poplar trees and associated undergrowth.

Land use towards the south consists of low density residential housing separated from the site by a Canadian National rail line. It has been estimated that this housing was developed in the late fifties and on through the sixties. This area of Transcona also has a number of maintained open green spaces that contain a wide range of sports facilities and play areas.

To the west of the site a more recent housing development called Lakeside Meadows was built in the late seventies and early eighties. This area includes several outdoor recreational amenities. A maintained green space around a storm water retention pond as well as a community centre and



The development of light industries is occurring along the north side on Gunn Road in the Municipality of Springfield. Source: H. G. Brumpton, 1996.


The west edge is defined by the private residences that have built fences.
8
6
1
Gunn Road
5
Gunn Road defines the study site's north edge.
7
9
Devonshire Drive
4
The study site's east edge is defined by utility lines.
The south edge of the study site is defined by several sets of utility lines and the Canadian National Railway.
2
3
Canadian National Railway
Edge Conditions
scale 1:5000
Analysis based on site visits and an aerial photograph taken in 1993. Aerial photograph was supplied courtesy of Manitoba Natural Resources.

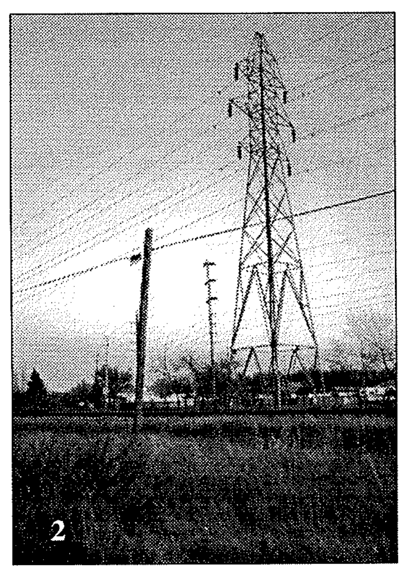
school with grounds that include sports fields and climbing equipment provide the community with recreational opportunities. All of the private lots along the west edge back onto the Transcona Domtar site with the majority having fences. Lakeside Meadows contains some higher density housing and the closest commercial strip mall but these are located some distance from the Domtar site along Plessis Road. It is clear from the airphoto that the residential development in this area had been planned to continue onto the Transcona Domtar site. The termination of Devonshire Drive is quite abrupt.

Beyond the immediate bounds of the site the current land use is either industrial or residential in nature. Some hay farming occurs on undeveloped portions of land within the Municipality of Springfield. Many of the industrial areas in the region are either support facilities for the railways or rely on their proximity to the railways for the delivery of raw materials and the shipment of their products.

The residential areas of Transcona as a whole contain a wide range of outdoor spaces. In addition to traditional outdoor spaces like ball fields, the range of outdoor recreation opportunities also includes a reserve of native tall grass prairie off of Regent Avenue, and the George Olive nature park in the eastern most area of Transcona. Kilcona Park, which was cited as one of the precedents for this project, is on the north edge of the region. Kilcona was designed with the intent to provide recreational amenity for the region. On the southern most edge of Transcona there is a golf course and cemetery that round out the green open spaces found within the community.

Facing: A diagram that describes the character of the study site's edges and the vantage points of each image. Sources: site visits and an aerial photograph supplied courtesy of Manitoba Natural Resources.

Below: A view showing the character of the south edge of the site as it is defined by three sets of utility lines and the CNR rail line. Source: H. G. Brumpton, 1993.



Design Implications

There are several design implications that arise out of the examination of the land use adjacent to the Transcona Domtar site. The variety of zoning types occurring around the immediate edge of the site will need to be addressed by the design proposal. Possible responses could include acknowledging the buffering potential of the Transcona Domtar site between potentially conflicting surrounding land uses. Another design implication is the quantity and variety of sports facilities located throughout the community and in the region is quite extensive. As a result there is little need to use the Transcona Domtar site to provide additional sports facilities.

3.2.3 Site Boundary Characteristics

All of the Domtar site's boundaries are clearly and strongly defined. The southern edge of the site is defined by several linear elements. Hydro towers, telephone poles and the Canadian National railroad are strong elements defining the site's southern boundary. Although these elements define the edge of the site in a strong visual manner, they do not inhibit the movement of people through or around them. Additionally, both sides of the railroad tracks are bound by drainage ditches which become reasonable barriers to pedestrian movement during wet periods. An abandoned road enters the site on this edge. It is posted with a *No Trespassing* sign but extensive use

Top Right: The entrance to the site on the south edge is well used even though it is posted with a warning sign. Source: H. G. Brumpton, 1993

Bottom Right: The east edge of the site as it meets Gunn Road. Evidence of use of the utility line corridor by all terrain vehicles is evident. Source: H. G. Brumpton, 1993.

Below: The utility lines of the east edge generate a strong visual edge but do not impede access to the site. Source: H. G. Brumpton, 1996.

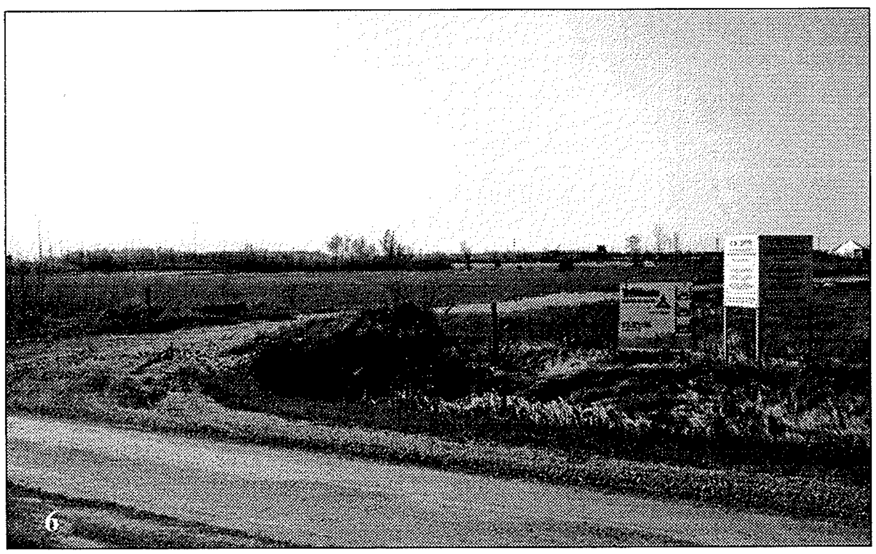
of the road for circulation is evident from the condition of the path's surface.

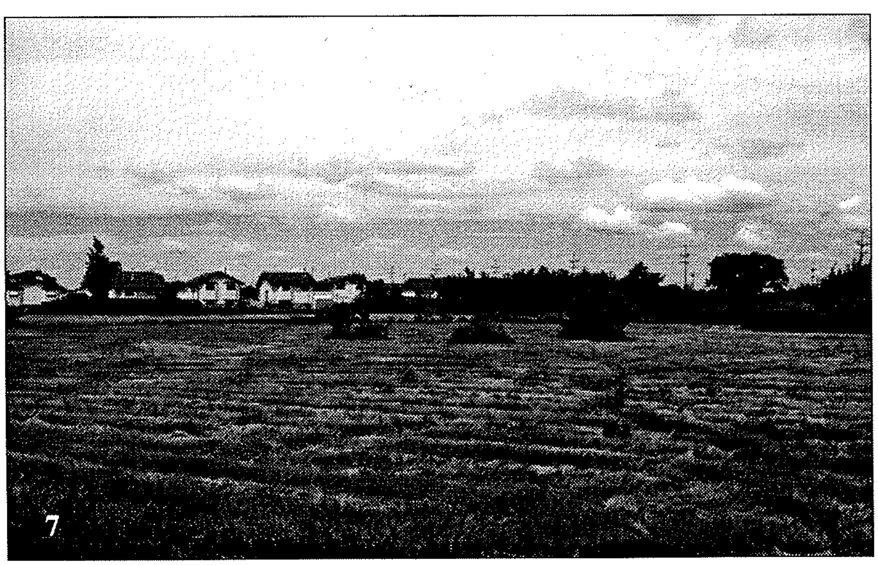
The strength of the eastern edge is developed from the double pole system of overhead utility lines. The lines cut through areas of trees which further contributes to the clarity of this edge. The lines act as purely perceptual barriers as they do not restrict entry to the site in any way. Heavy use of this corridor is evident from the trails left from all-terrain vehicles.

The northern edge of the site is defined by Gunn Road which at present is surfaced with gravel. From the road one can see well into the site. This side of the site is the only one which provides large and relatively unimpeded views of the site. Access to the site is made more difficult because

Top: A view of the entrance to the site from Gunn Road. Source: H. G. Brumpton, 1996.

Bottom: A view from the Gunn Road entrance to the houses that form the western edge of the site. Source: H. G. Brumpton, 1996.

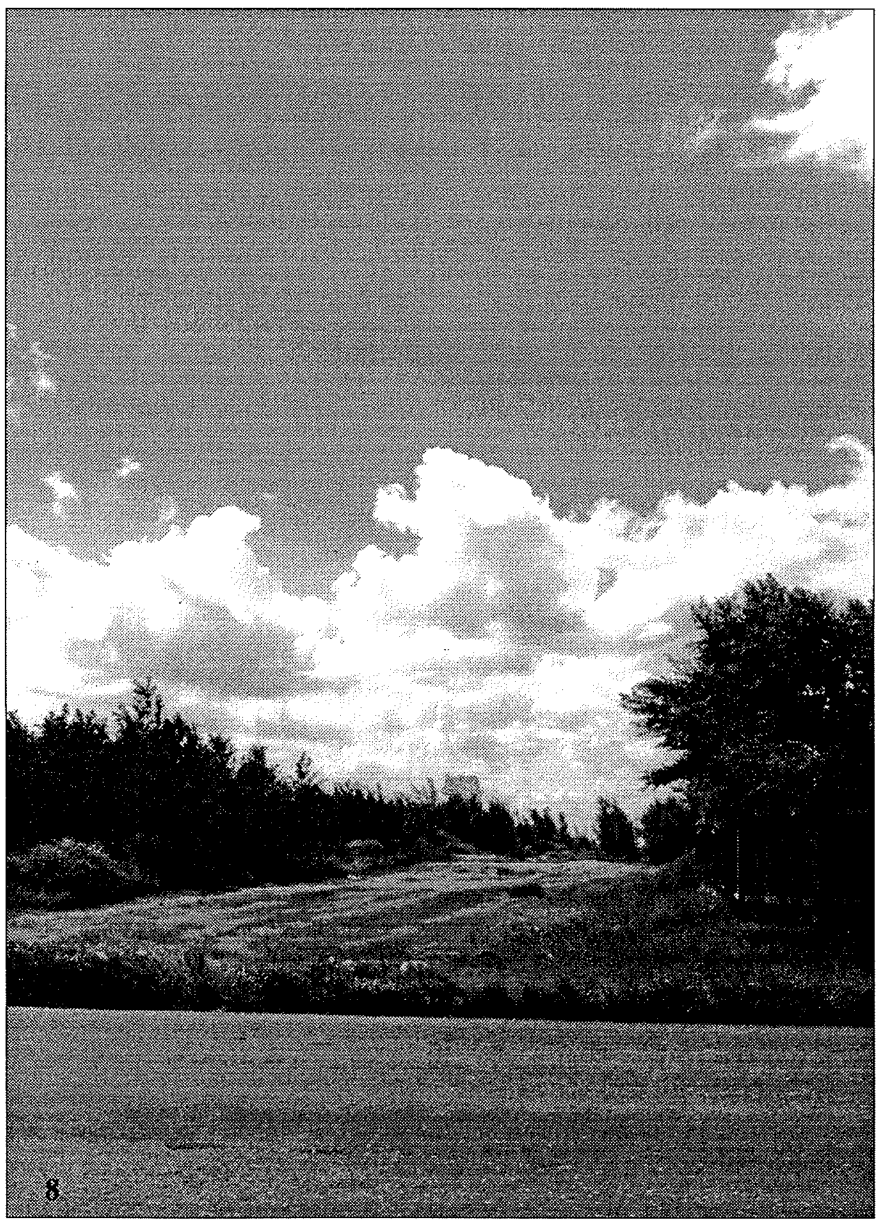




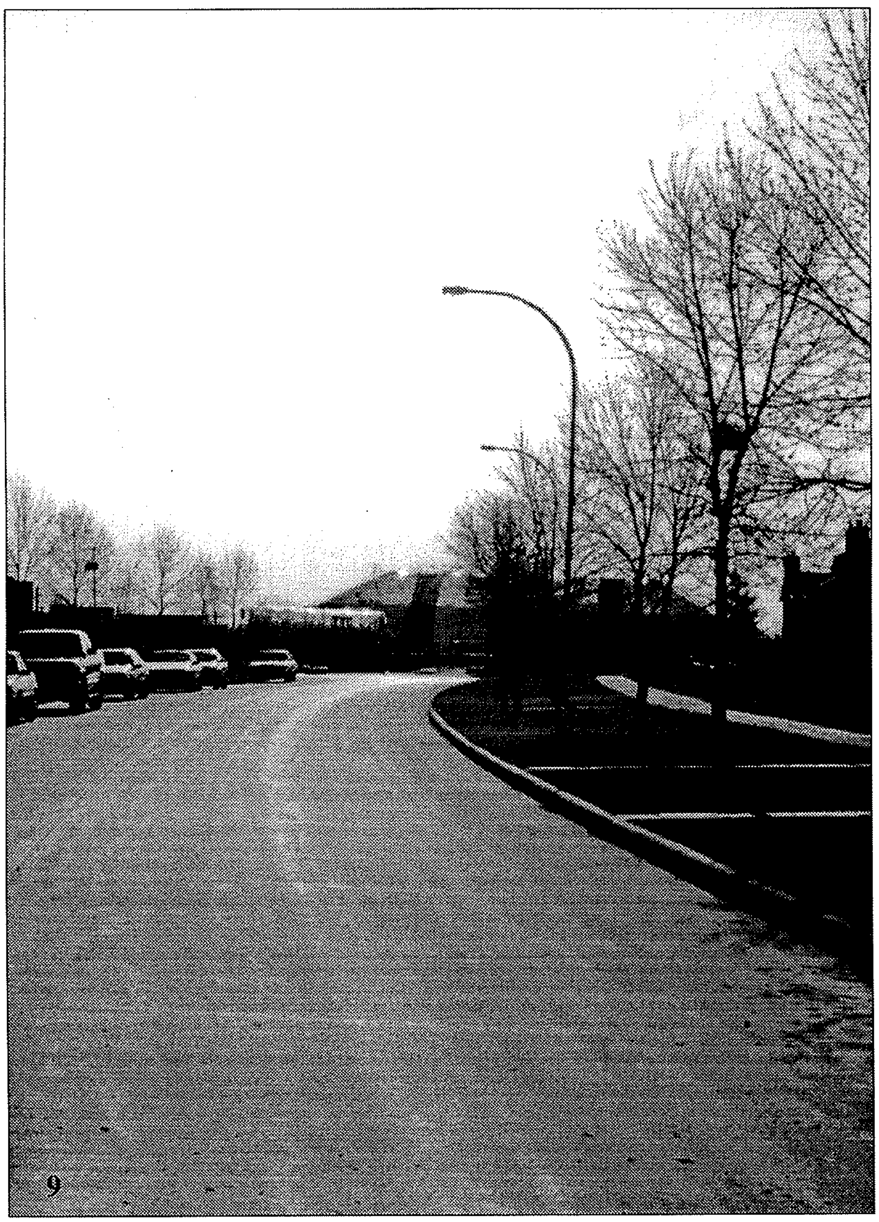
of a drainage ditch running the length of Gunn Road. The ditch is currently bridged by a single road that traffic associated with the remediation efforts has used to gain access to the most highly contaminated areas of the site. The north edge of the site is the only one that would afford a variety of entrance points to be developed.

The western edge of the site is primarily defined by those private residences that have built fences. A swath of approximately 8 metres is maintained between the fences and the tree and shrub vegetation of the site. The

A view of the western edge of the study site. This edge consists of a mown swath and the remnants of a fence. Source: H. G. Brumpton, 1996.



remnants of a low wire fence also define the character of this edge. This maintained corridor is used for pedestrian circulation towards its south end. This edge is the most sensitive and least defined. The immediate relationship between the activities on the Transcona Domtar site and the private residences is a condition that must be carefully considered as part of any development proposal for the site. At present, there exists little if any buffer between two highly incompatible land uses, land remediation and housing.



A view from Devonshire Drive looking east towards the Domtar site before the tent structure housing remediation technology had been removed. Source: H. G. Brumpton, 1996.

Design Implications

Design implications that have arisen from the analysis of the conditions of the site's edges include most importantly, the need to address the sensitivity of the site's western edge. The clarity of the other edges could serve as a constraint should the intent of future development be to encourage use of the site. This would result because of existing physical and perceptual barriers between this site and the rest of the community are strong.

3.2.4 Summary of Design Implications

The site's clearly defined boundaries create physical and perceptual barriers that will need to be overcome if the intent of the design proposal becomes the integration of the site and the community. The residential areas bordering two sides of the site are well serviced with open green spaces that support a range of recreational facilities. There seems to be little justification for recreational activity development on the site. The industrial land use which borders the site is another issue which must be given consideration in the design. The history of the community based on the influence of the railways is important. The strong sense of identity that has developed from the community's history and its well-defined boundaries are the final important design issues identified within the contextual analysis.

3.3 Community Survey

A survey of part of the community of Transcona was undertaken in the fall of 1993 by a class of landscape architecture students from the University of Manitoba. The survey was undertaken as part of course requirements and was coordinated by Professor S. Weidemann from the University of Illinois. The survey had three components. The first component was undertaken with students at the elementary and junior high school levels. The second component was undertaken with students at the high school level, and the third component was an adult study distributed to homes in the neighbourhood surrounding the Transcona Domtar site. This study as a whole was designed to provide the researchers with insight into the perceptions, contentions and even fears held by the various members of the surrounding community over the suitability and usefulness of this site in future neighbourhood planning and design.

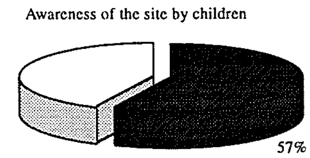
3.3.1 School Surveys

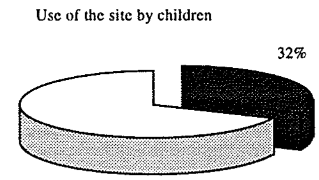
This section contains information generated in two separate surveys of school aged children. It begins with discussion of the elementary and junior high school surveys and is followed with a very brief discussion of the high school survey.

Methodologically, the elementary and junior high school survey began with a literature review that dealt with among others, topics such as children and the natural environment, children and their community, and a child's perception of their neighbourhood. No literature was found that addressed children and polluted or post-remedial landscapes. Subsequent to the literature review and survey design, the survey was conducted in one class of each grade ranging from 4 through 9. Each survey was done at the same time over a class period of 35 to 40 minutes. The controlled delivery of the survey questions resulted in very high response rates.

There are many important results generated by this survey, of which only a sample will be discussed here. Demographically, the survey sample totalled 131 students with an age range from 8 to 14 years. There were 64 male and 65 female respondents. Overall it was found that the group was almost evenly distributed between ages, grades and genders. After the demographically based questions, basic neighbourhood perception questions were generated. In this section of the survey most subjects responded that they either liked their neighbourhood or liked it a lot. Most subjects also responded that their neighbourhood was friendly, attractive, safe, quiet, clean and fun.

Awareness of the Transcona Domtar site became the focus of the next section. A total of 74 (57%) of the respondents reported that they knew of the site, while 41 (32%) of the total respondents said that they go to the site. Use of the site centred around weekend times and in the summer months. A site map was also generated in this section. Words used as labels for the map by elementary level students included chemicals, fire, and construction. This map indicated the knowledge that children have of the site, but most importantly it indicated their perceptions of the site itself, as a place associated with negative things. The junior high school group used words like polluted, smelly and cursed to describe the site. The subjects' overall perception of the site was concluded from the mapping exercise to be negative in nature. Yet despite the dangers, risks and negative perceptions of the site, the children indicated that they use the site for recreational and social





The graphs illustrated above show the number of respondents to the elementary and junior high school surveys who indicated they knew of the Domtar site and the number who indicated that they use the site. Source: Weidemann, 1993b.

functions (Weidemann, 1993b). It could be due to the site's off limit nature that children find it more intriguing and attractive as a play place. The fact that children tend not to readily perceive long term risk can also play a part in explaining the use of the site reported by the students.

The survey of high school students generated worthwhile information. A total of 75 percent of the respondents to this survey were familiar with the site although most never use it. 'Hanging out' and 'bush parties' were listed as the most popular activities occurring on the site at present, but most respondents more often undertake these types of activities at other locations throughout the community. Generally, high school aged children had positive perceptions of their community but a negative perception of the Transcona Domtar site. The negative perception of the Domtar site could not be contributed to any of the physical deterrents measured in the survey. Finally, most of the respondents to this survey were unaware of the environmental problems that plague the Transcona Domtar site (Weidemann, 1993c).

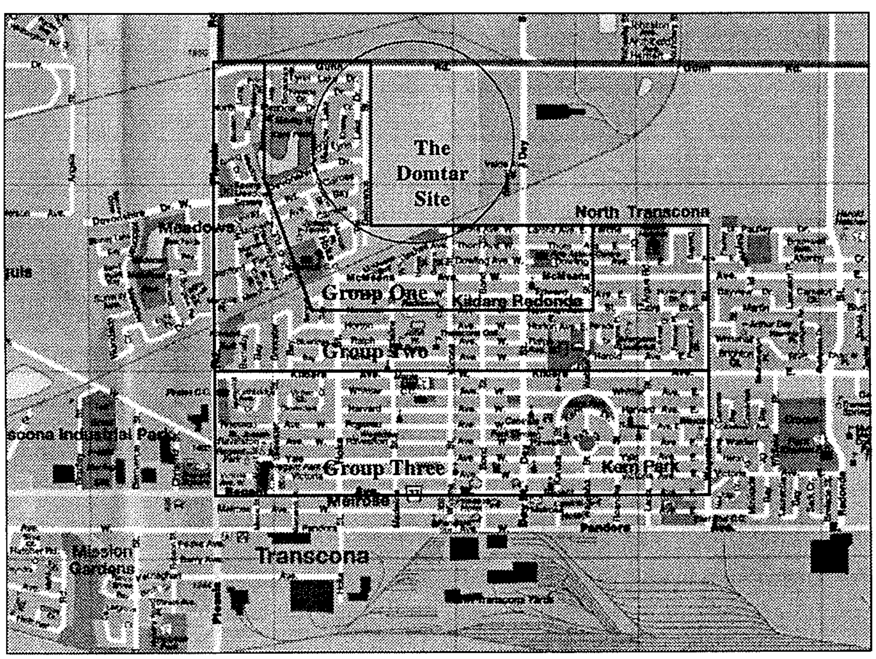
Design Implications

Many implications for design can be drawn from the school surveys. From a younger child's point of view the site is large and for the most part inaccessible. The inaccessibility of the site occurs mainly because the majority of it is beyond what can be described as a child's home range. Any development aimed at a child of this age needs to occur in a zone accessible to this age group, most likely in the southwest section. Separation of age groups is also important because the listing of least favourable places tended to be based upon social concerns. At the time of this study the Transcona Domtar site was not part of the children's cognitive map, except as a boundary to their neighbourhood. This can be concluded because so few younger children listed it or were even aware of it. Landmarks within the site would be a way to give identity to the site and generate a sense of place for gathering. Finally, access through the site, the adventure possibilities of the shrub areas and their edges, as well as secluded gathering areas, have also been identified as important. Variations of these environments could be incorporated into a design for the site that was focused on the age group of children that this survey questioned.

3.3.2 Adult Survey

The final component of the complete community survey was an adult survey distributed to private residences surrounding the site. The central issue of the adult residential survey was that commonly held perceptions of the potential users of landscapes appear to govern the overall use of a space. As a result, if an area is perceived to be dangerous and unhealthy, it is often devoid of use and activity. Other issues confronted within the adult survey centred around the community's concerns regarding the Transcona Domtar site. The issue of how distance from the site affected these perceptions was examined by grouping the community into three zones; adjacent, intermediate, and peripheral, in relationship to the former Transcona Domtar site. It was intended that an analysis of respondents' perceptions in conjunction with current use of and future expectations for the site would provide helpful considerations in planning for a beneficial, more appropriate use of the existing site.

The objectives of the adult residential survey were three fold. It intended to identify the perceptions of residents within three areas of study surrounding the Transcona Domtar site. Second, it intended to examine whether the people who are most concerned about the Transcona Domtar site can be convinced of the positive aspects of a regenerated site. Finally the study endeavoured to focus on the demographic factors which may illustrate how perceptions varied. The study consisted of the distribution of



The boundaries defining each of the three adjacency zones in the adult residential survey. Sources: Weidemann, 1993a and Map Art, 1995.

300 questionnaires to randomly selected households in each of the three previously mentioned zones.

This examination of the survey results is meant to be general in nature with a highlighting of salient points most relevant to the study at hand. The survey provided many interesting insights into the perceptions, values and even the demographic composition of the residents who live adjacent to the Transcona Domtar site. Demographically, the respondents were split 54 to 46 percent females to males and there was no significant difference found between any responses based on gender. The majority of respondents ranged from 32 to 38 years of age. A range of education levels was reported. Like gender, no significant difference could be found with regards to education levels reported and responses to questions given elsewhere in the survey. A total of 97 percent of respondents owned their homes and 41 percent of the respondents had lived in Transcona for more than 10 years.

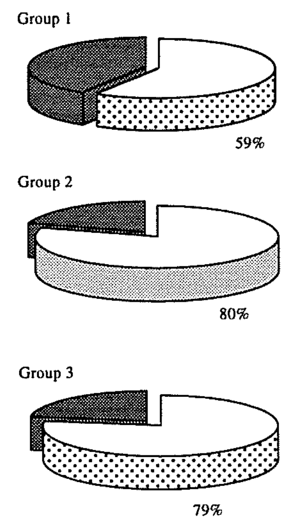
The first questions asked were general and introductory in nature and referred to the community as a whole. Health considerations were given as a reason why 49 percent of respondents would move away from Transcona. The closer the respondent lived to the site, the more important general health issues became. Even given the focus on health concerns, a total of 90 percent of the respondents enjoyed living in their community.

Next, a series of questions about environmental quality relating to the community as a whole were asked in the adult survey. The first question of this section asked how important outdoor leisure activities were to the respondent. Seventy-two percent of respondents felt that outdoor leisure activities were important and a significant number of them also felt that these activities were educational. The next question dealt with the perceptions of safety from health hazards in the community. Only 38 percent of respondents were satisfied with safety from health hazards in their community. The area closest to the Transcona Domtar site was significantly less satisfied with safety from health hazards than the other areas. Overall, 72 percent of respondents were satisfied with the general environmental quality of the community but there was a considerable range shown in responses to this question which was based on proximity to the Transcona Domtar site. Within the area closest to the site only 59 percent of the responses were satisfied with general environmental quality of their community. In the middle area, the response rate to environmental satisfaction in the community was 80 percent. The most distant area, number three, responded at 79 percent satisfaction to the same question.

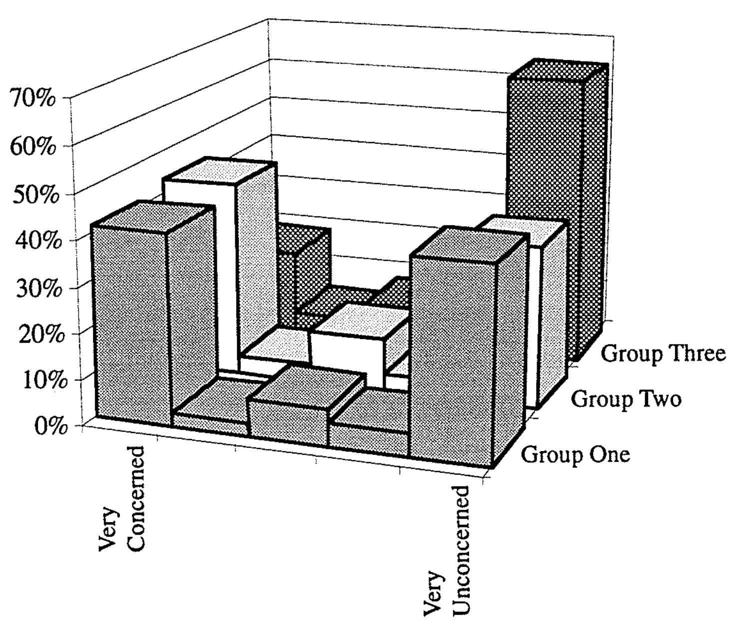
After the questions that were based on the community as a whole, questioning focused onto the Domtar site specifically. When asked about the Domtar site, only 50 percent of the respondents from the closest group expressed satisfaction with the general environmental quality on the site. The expressions of satisfaction increased to 61, and then 85 percent as groups farther from the site responded. The results of this section tended to be very polar in nature, with responses showing either complete concern or complete apathy. It was observed from the responses that the middle group in terms of proximity to the Domtar site felt the strongest overall. This concern may have been generated because this group is close enough to be aware of the site and the activities that occur there, yet are far enough away to comfortably point out perceived dangers. Also of relevance, it should be noted that 63 percent of all the respondents indicated never having been to the site.

The survey included a map of the site and its immediate context which was part of a question asking where if at all, use of the site occurred either as observed by, or done by, the respondent. It is interesting to note here that the most popular entrance to the site, at the end of Devonshire Road, is also the area of maximum contamination and the focus of the most intensive remediation activities.

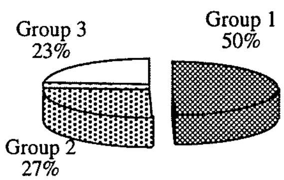
The next series of responses was based on the values held by the respondents. As it existed at the time, 37 percent of the respondents would



Above: Three graphs that show the proportion of respondents to the adult survey who expressed satisfaction with the general environmental quality in their community. Each graph represents a zone established to define proximity to the Domtar site. Source: Weidemann, 1993a.

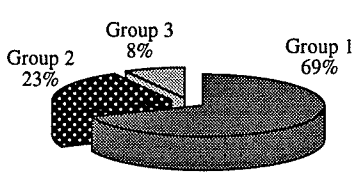


Below Left: A graph that shows the polar nature of responses to the question dealing with concern in regards to the environmental quality of the Domtar site. Source: Weidemann, 1993a.



Above: A graph showing the adjacency group from which those respondents who were dissatisfied or strongly dissatisfied with the current state of clean up. Source: Weidemann, 1993a.

Below: A graph showing the breakdown by proximity group of the 18 percent of respondents who believed that the economic value of their homes had decreased as a result of the activities at the Domtar site. Source: Weidemann, 1993a.



avoid the site entirely. A total of 81 percent of the respondents considered themselves environmentally concerned yet also expressed neutral feelings toward the current state on environmental protection and hazardous waste clean up in the province. A total of 18 percent of the respondents believed that the economic values of their homes had been decreased because of the problems at the Domtar site. The greatest dissatisfaction with the state of remediation was voiced within the closest group to the site, again emphasizing that adjacency to the site is a very important factor influencing perception. Most respondents expressed a desire for more information on the site. Their sources to date were listed as from newspapers, television and from their neighbours, with the newspaper seen as the most credible. All respondents wanted more information about the site, with those closest wanting information on future development proposals, and those farther away desired information on the site's present condition.

The final section of the questionnaire inquired about different future possibilities. Several site uses were presented. A nature education facility was the most popular of the alternatives presented. It was supported by 57 percent of the respondents. Recycling and composting facilities and recreation and sports facilities were supported by 44 and 54 percent of respondents respectively. Proposals that were not supported included apartments, commercial development such as malls, and industrial uses. The Fort Whyte Centre was listed as a desired type of development in the open ended portion of this section of the questionnaire by a number of respondents.

It was concluded from the information generated by the survey that a high level of environmental concern exists throughout the three zones studied. Dissatisfaction with the Transcona Domtar site's current state of environmental quality appears highest as adjacency to the site increases. Interestingly, the group which reported the greatest use of the site was also that which is closest to the site and reported the previously mentioned dissatisfaction with its current state. And finally, it was observed from the survey results that all three of the zones examined indicated that outdoor leisure activity within their community was an important amenity (Weidemann, 1993a).

Design Implications

Several important design implications arose from the adult resident survey but fundamentally any proposal must acknowledge that the site is going to have to appear attractive and safe to users, especially those closest to the site who will be impacted most significantly by changes in land use. It was interesting to realize that a total of 90 percent of respondents enjoy living in this community. This indicates that a strong sense of community has been developed by the residents of this area. A design proposal whose intent is to generate use of the site by residents, that also attempts to connect with the strong sense of community, has the potential for greater success. Yet, from the survey results, it becomes quite evident that residents do not feel that the Domtar site is presently part of their community. There appears to be a great deal of animosity towards the site and a resultant fear coupled with a general unawareness of happenings there. To address this concern, the design proposal, as well as its development process, could each be highly significant events involving the community.

A total of 81 percent of respondents were environmentally concerned. The respondents also agreed with the need to protect the environment in their community. Each of these pieces of data suggests that the design of the site should incorporate environmental issues, and that these issues would be appreciated by the residents, which would contribute to the success of the site. A design proposal could also convey a sense that the site has been reclaimed, which would, in turn, promote understanding and possibly use. People using the site will provide the opportunity for a connection to the site to be developed by them which would thereby address the psychological discomfort the polluting of the site has generated.

The perceptions and beliefs section of the survey showed that the group closest to the site has been dissatisfied with the current state of cleanup. This was expected. Adjacency is an important concern with regards to design on this site. The residents closest to the site will be the most impacted by a change in land use. They will have the strongest response to changes in land use either negatively in the case of an ill-conceived redevelopment, or positively in the case of a successful redevelopment that sparks interest and use of the site. It is therefore critical that their interests be understood and taken into consideration.

It is interesting to note that 70 percent of the respondents wanted to have more information on the site's current environmental condition. The opportunity lies here to create a program for the site that dispenses information. This information could be focused on environmental issues and would therefore address the site's remediation as well as how the site responded to the past 65 years of industrial activity. The positive response to the development of a nature education park is significant as it underscores the importance placed on nature and education by the community. It also represents the synthesis of the desire for more information and increased awareness, as well as the value placed on opportunities to interact with nature by the survey respondents. It is therefore important that any function proposed for the site consider this type of use, and most specifically the educational component. Portions of the site currently provide natural vegetation that exhibit a successional cycle. This is a potential starting point for any kind of nature education facility. The opportunity to develop a nature education facility is further supported by the respondent information section which indicates that those respondents closest to the site are the youngest and that this neighbourhood also contains a significant number of children. Educational opportunities for children would have positive long terms effects for society in general, as these children would be able to acquire a greater awareness of environmental issues and processes that would hopefully allow for this type of environmental problem to be avoided in the future.

3.3.3 Summary of Design Implications

The survey of both children and adults showed that the site is not considered part of the community. There is use by adolescents and adults. A strong community identity was also identified from the survey results which is an issue that can be capitalized on in a successful design. In general the adult respondents expressed significant environmental interest both at the scale of the community and in terms of the Domtar site. Finally, adjacency was shown to play a significant role in shaping perceptions of the site.

3.4 Physical Environment

Three areas of analysis are grouped into this section. An analysis of the site's soil characteristics is followed with an analysis of the site's hydrology and topography. Within each of these three topic areas the design implications realized from the analysis will be discussed.

3.4.1 Soil Characteristics

Soil characteristics are important to consider as part of any site analysis because they have value as an engineering material and as a plant medium. In the case of the Transcona Domtar site the soil is also important because it has been the recipient of pollutants.

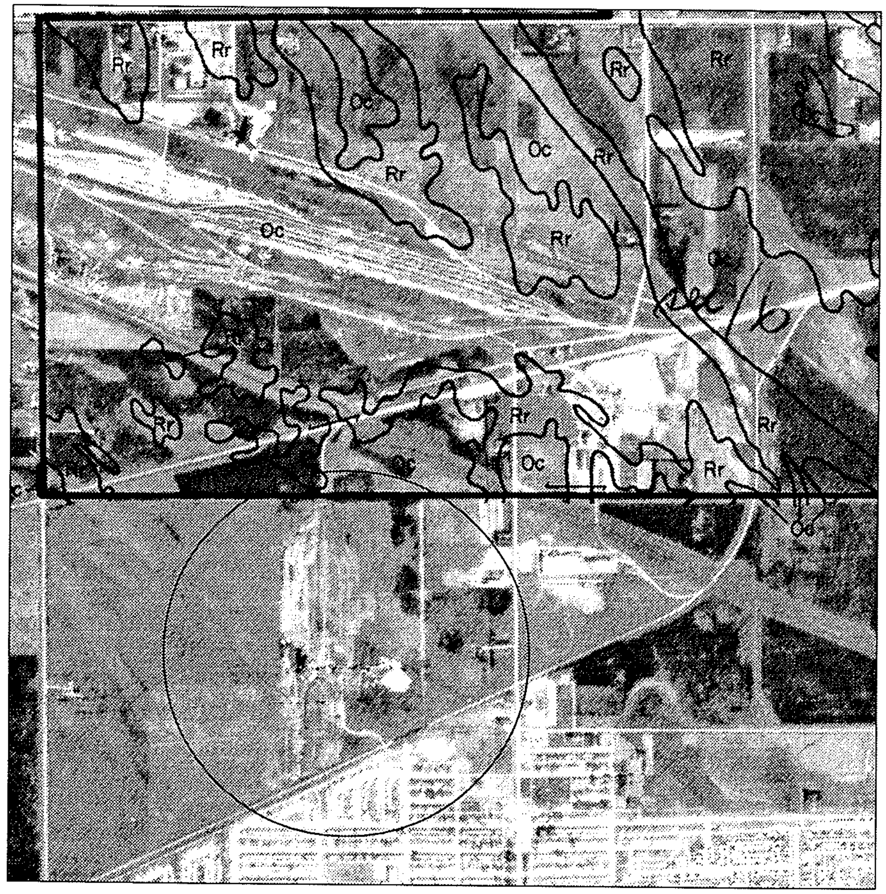
The soil of the landholdings north of Gunn Road were surveyed as part of a 1975 soil survey of the region surrounding Winnipeg. Red River Clay and Osborne Clay are the two primary soil types of the adjacent landholdings. Red River Clay is considered a gleyed rego black while the Osborne soil has been classed as a rego humic gleysol. Since the survey did not extend over the site's boundaries, it has been assumed that either or both of these soil types will constitute the soil types of the Domtar site.

Osborne Clay soil is characterized by a thin partially decomposed organic layer that is 5 to 15 cm thick, a very dark to dark gray Ah horizon 10 to 18 cm thick and a dark gray to olive gray calcareous C horizon. A thin AC horizon may be present below the Ah horizon that is light gray. The light gray colour has resulted from prolonged saturation and a reducing condition. Distinct to prominent mottles may be present in the C horizon. The typical topographical condition of this soil type is depressional which contributes to the soil's extremely poor drainage. Runoff is characterised as negligible to very slow and permeability is also very slow (Michalyna, 1975).

Red River Clay is imperfectly drained which is slightly better than the drainage characteristics of the Osborne Clay. The Red River soil type is characterized by a very dark Ah horizon 13 to 30 cm thick which tongues into the dark greyish brown (moist) or gray (dry) calcareous AC horizon and a gray to olive gray C horizon with fine mottles. Topography is level to very gently sloping; runoff is slow and permeability is slow but may be moderately slow in the lower horizons containing thin varves of silty deposits (Michalyna, 1975).

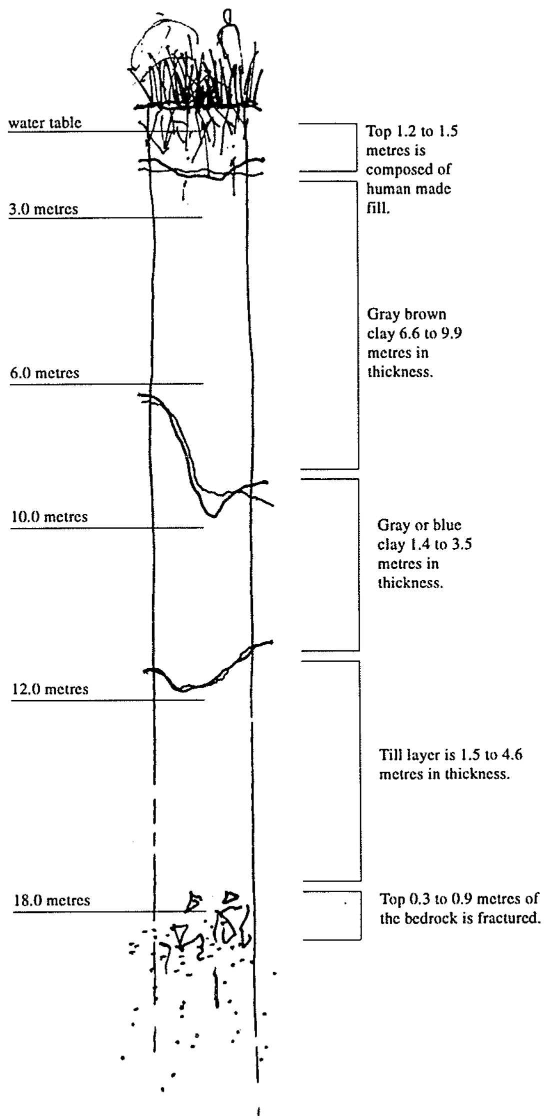
The Red River and Osborne Clay soils have been classed with regard to potential land use as part of the survey completed by Michalyna in 1975. Each of the two relevant soil types are very similar in their characteristics. From a recreational perspective, Osborne Clay is given the poorest rating for all categories. These categories are defined as intensive play, picnic, camp areas as well as suitability for paths and trails and building sites. It is poorly drained, is subject to ponding, is very sticky and slippery when

A map prepared as part of a 1975 soil survey of the region adjacent to the city of Winnipeg that shows a soil landscape of primarily Osborne (Os) and Red River (Rr) clays. The Domtar site is just south of the surveyed areas. Source: Michalyna, 1975.



wet. Red River Clay is also slippery and sticky when wet and is also subject to ponding as a result of its poor drainage characteristics. It is rated as very unsuitable for intensive play, picnicking and camping, but moderately unsuitable for paths and trails and the development of recreation support buildings (Michalyna, 1975).

Both of the soils discussed here have also been categorised for their suitability for use as a building material. For use as a topsoil, a road fill material, or for extracting sand or gravels, both soils are rated as poor. Soil features affecting road location are their high critical volume change, high compressability, and high plasticity. Features affecting foundation construction are again its high compressability as well as high critical volume change and low bearing capacity when wet. Drainage is required to use either soil for agriculture. For the development of water retention structures the soils have slow permeability which is good. As an embankment



A diagram that shows the average depths of the various soil layers present in the disturbed areas of the study site. Sources: based on information presented in the consultants' reports, MacPlan, 1992 and UMA, 1996.

material, the soils have high shrink swell characteristics and high compressability (Michalyna, 1975).

At the Domtar site in the areas most heavily disturbed by the wood treatment activities, the top 1.2 meters to 1.5 meters is comprised of human made fill material that consists of sand, gravel, and wood chips (Cherry and Smith, 1987). Construction materials like brick and concrete were to have been removed as part of the remediation program. This upper layer of material could present difficulties with regard to construction. Debris such as spikes and missed pieces of concrete could prove dangerous to users in the future or could complicate construction activities. Differential settling rates could complicate building design.

The underlying geological strata consist of a clay layer between 9 and 12 metres thick, which was laid down as sediment under glacial Lake Agassiz between 13 500 and 8000 years ago (Cherry and Smith, 1987). The upper 6.6 meters to 9.8 meters is a weathered brown or mottled gray-brown colour, whereas the lower section is typically gray or blue. The brown silty clay is highly fractured, has numerous silt pockets, lamina, and nodules, and is relatively brittle. Gypsum crystals appear as filling in some fractures. There is a clearly discernible break between brown and gray clay layers. The gray clay is 1.4 meters to 3.5 meters thick. This layer is very soft and pliable, becoming increasingly so as the till layer is approached. No fractures have been observed in the gray clay layer. A clearly discernible break exists between the gray clay layer and the till layer below (Cherry and Smith, 1987).

The till layer in this profile is 1.5 meters to 4.6 meters thick. The till has a clay silt matrix and carbonate rock fragments. The upper part of the till is characteristically soft, wet, uncemented, and ranges in thickness up to 3.6 meters with an average thickness of 1.0 meter. The lower part of the till is usually highly cemented with calcium carbonate and exhibits hairline fractures. Below the till layer is a limestone bedrock layer. The upper 0.3 meters to 0.9 meters is usually highly fractured and disturbed, and often is intermixed with preglacial sands and gravels. Deep irregular fissures and depressions which contain rock fragments, sand, silt, gravel and clay have been noted by the consultants studying the site (MacPlan, 1992).

3.4.2 Hydrology

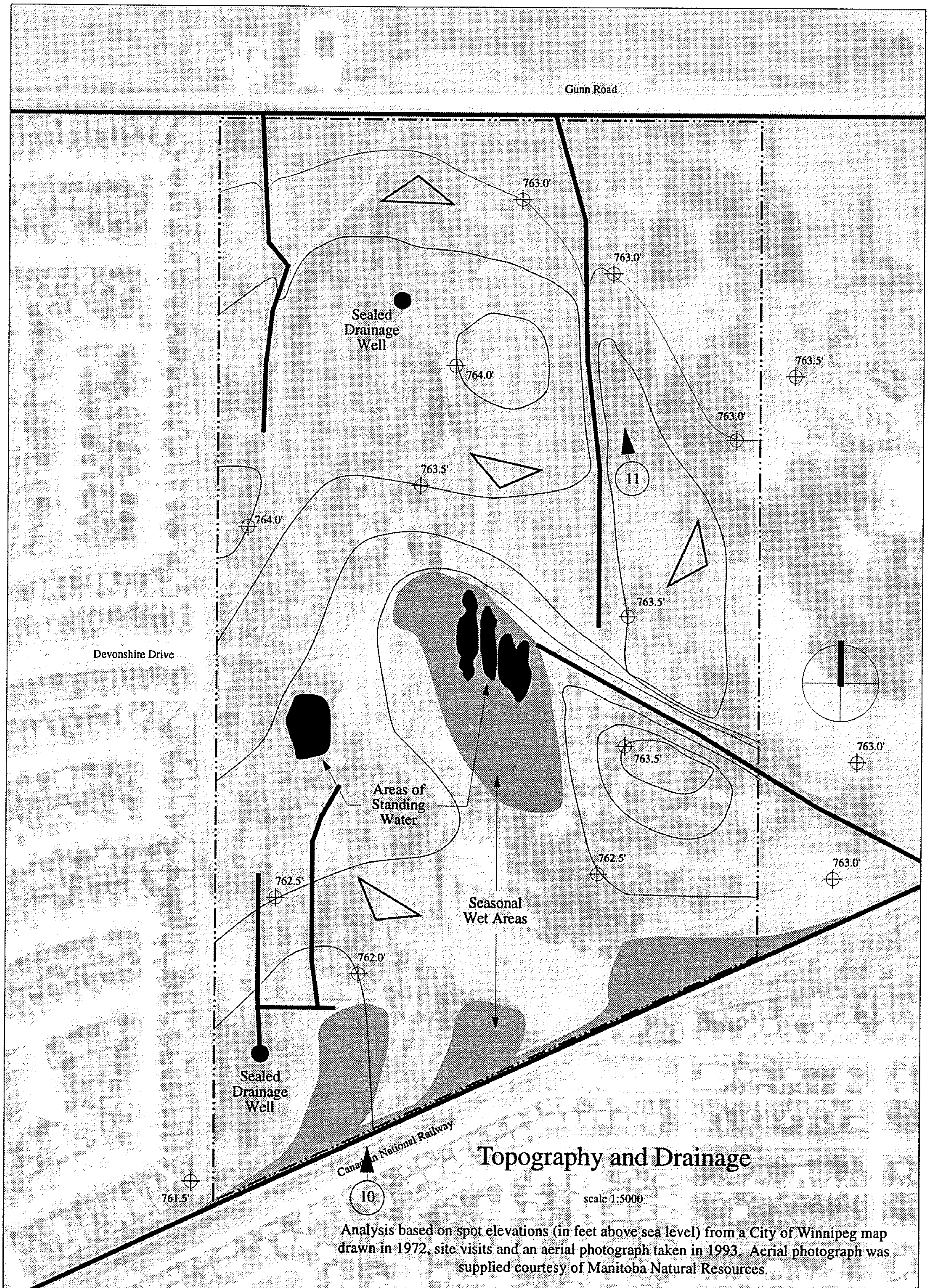
As discussed in the previous section, the soil types of the Domtar site have low hydraulic conductivity. This is a measure of the rate at which water can move through the soil. The upper brown clay layer has an average bulk hydraulic conductivity of 2.6×10^{-10} m/s to 3.2×10^{-9} m/s. The gray clay layer has a hydraulic conductivity on the order of 10^{-11} to 10^{-13} m/s. An important hydrological property of the lower gray layer is that it impedes recharge of the upper carbonate aquifer and consequently restricts transport of the pollutants from surface sources (MacPlan, 1992). The till has a higher conductivity than the clay and its equilibrium water level is relatively high.

In the Winnipeg area there are four bedrock aquifers. The upper carbonate aquifer is the major aquifer of these four and is of the greatest interest when considering ground water pollution. This aquifer occurs in the top 15 to 30 metres of the limestone bedrock (Cherry and Smith, 1987). It is partially confined on the top by till and clays and on the bottom by the relatively impervious dolomitic limestone. The upper 7.5 metres of the upper carbonate aquifer is the major zone of permeability because of the larger frequency and size of fractures, joints, and solution cavities. The upper carbonate aquifer is recharged in the Birds Hill region northeast of Winnipeg. The regional ground water flow direction for the upper carbonate aquifer below the Domtar site is from the northeast to the southwest and the water levels are between 222.2 and 221.6 metres above sea level. Flow patterns vary both seasonally and diurnally (MacPlan, 1992).

Prior to the pumping of the upper limestone aquifer for human use, which is believed to have began about 100 years ago, ground water flow in the clay soils was upward, due in part to the transpiration of plants. The consultant's report indicates that the water table in the northeast section of the Winnipeg area ranges in depth between 1.5 to 3 metres below the surface of the ground (MacPlan, 1992). On the Domtar site the water table level has been observed at less than 0.5 metres below the surface. The nearly saturated conditions of the soils on the Domtar site is a design constraint which will need to be addressed in any proposal. Options include bringing substantial quantities of fill or regrading and shaping of the site's topography or accepting that the site is a wet meadow. A wet meadow is a unique form of habitat that could become an underlying theme for the nature education centre.

3.4.3 Topography and Drainage

The Domtar site is extremely flat. Any noticeable topography is most likely the result of human intervention on the site during the operation of the wood preserving plant, or during the subsequent period of remediation. Spot elevations were found on a city of Winnipeg map of the region and were interpolated. These indicate that the lowest area of the site is in the Southwest along the rail way. The highest area relative to the rest of the site



Topography and Drainage

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Analysis based on spot elevations (in feet above sea level) from a City of Winnipeg map drawn in 1972, site visits and an aerial photograph taken in 1993. Aerial photograph was supplied courtesy of Manitoba Natural Resources.

is in the central northeast portion. The difference in elevation between the highest and lowest points on the site is approximately 0.8 metres.

Observations of the site during wet spring periods have indicated that the undisturbed northeast portion of the site is the best drained. Central areas, as well as those areas to the south and west, are subject to ponding. Several drainage ditches were constructed during the plant's operation and these still function to drain water off the site. Ditches run to the north as far as Gunn road and from the centre of the site to the southeast to the railway. A ditch also follows the western edge of the site from the most heavily polluted area to Gunn Road. Remediation efforts have resulted in the removal of a storm water retention pond that was located in the centre portion of the site. These efforts have also resulted in the filling of several dry wells previously used for surface drainage. The remnants of an evaporation pond also acts as a collector for surface water runoff.

Because of the lack of significant topography, the opportunity exists to aid drainage and at the same time provide some spatial definition by creating landforms. The opportunity also exists to contain the runoff on the site instead of directing it off the site. In this way, any residual contaminants can be kept from leaving site to contaminate neighbouring sites. The collected water could be used to establish a water feature such as a marsh.

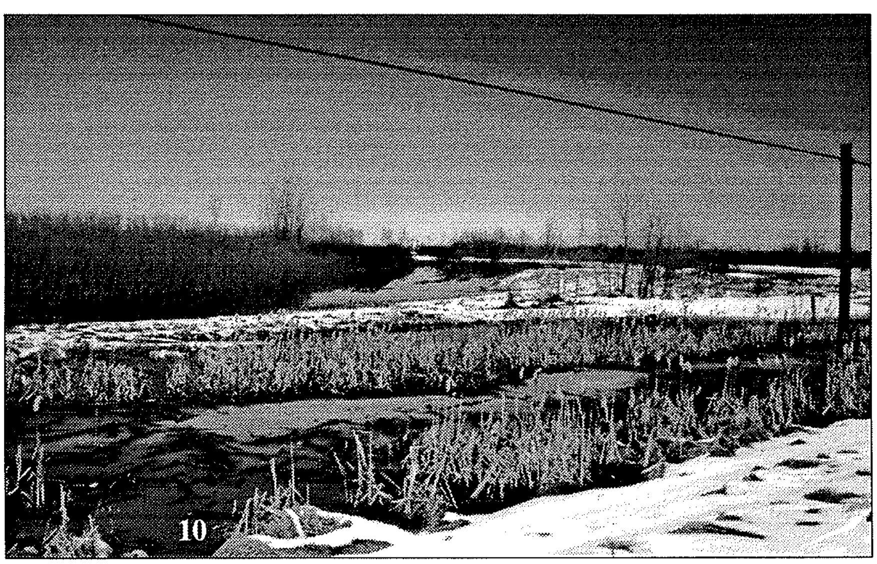
Facing: A plan diagram showing the drainage characteristics of the study site. Sources: a City of Winnipeg map drawn in 1972, site visits and an aerial photograph was supplied courtesy of Manitoba Natural Resources.

Below left: The south edge of the study site is well defined by the ditch of the rail way that floods into low lying areas. Source: H. G. Brumpton, 1996.

Below: A view of the ditch draining the site north to Gunn Road. Source: H. G. Brumpton, 1996.

3.4.4 Summary of Design Implications

The site has no significant topography and a high water table. It is therefore subject to ponding of water during periods of heavy rain and in the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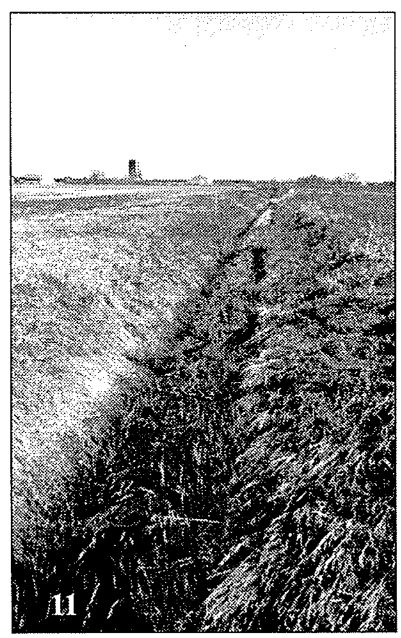
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spring melt. Drainage of water is currently directed off the site with ditches but could be kept on site to support wetland habitats. The soil types are generally considered to be poor for supporting recreational activities like sports fields but will support a unique wet meadow habitat. The soil types are suitable to the development of water retention structures and embankments because of their low permeability and high compressability.

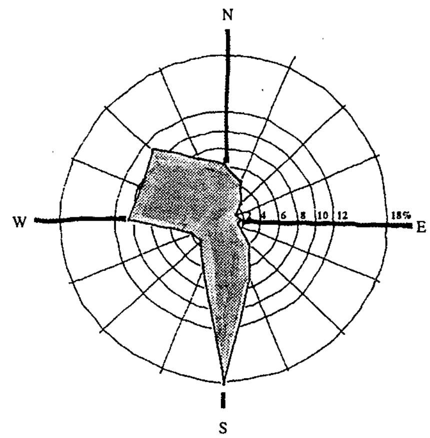
3.5 Climate

The climatic analysis of the Domtar site will examine first the wind patterns through seasons, followed by annual precipitation data, temperature regimes, and final design issues that arise from the amount of sunlight received at the site. The relative distribution of air temperature, relative humidity, wind direction and force determine the effective temperature and its relation to the human comfort zone. Precipitation helps determine the importance of shelter and expected drainage requirements. While the sun path is consistent for similar latitudes, the hours of sunlight expected in an area is not as consistent. The hours of sunshine for a specific site indicate the relative importance of providing summer shade or encourage the collection of solar radiation.

3.5.1 Wind

The speed of the wind and its direction have a great impact on comfort. In the case of any polluted site, wind also determines the direction in which the pollutants will travel from a source and consequently, the area and receptors which will be affected by the pollutants emitted by the source (MacPlan, 1992). Based on data from the Atmospheric Environment Service, it can be seen that the average annual wind speed in the area was 4.6 m/s (AES, 1993). The average annual wind speed for any specific direction varied between 3.6 m/s and 5.4 m/s. For approximately 66 percent of the time the wind speed was less than 5.1 m/s which corresponds to the wind speed soil erosion threshold (MacPlan, 1992). Conversely, the wind should be greater than the threshold wind speed less than 34 percent of the time. The wind speed was greater than 10.8 m/s about 2.3 percent of the time.

The predominant wind directions and speeds on an annual basis can be seen using the annual and seasonal wind roses. The prevailing wind direction in this region is from the south about 17 percent of the time. The northwest wind is also important, and from this quadrant encompassing west, northwest, and north, it blows 41 percent of the time. The annual average frequency of calm periods, based on the threshold wind speed on the anemometer, is 3.2 percent at the Winnipeg Airport.



An annual wind rose showing the frequency of wind direction. Source: based on data from 1982 to 1991 generated by Environment Canada (AES, 1992).

In terms of the specific microclimate of the Domtar site, the wind travels through the corridors between stands of shrubs which can alter its speed and intensity. The west edge of the site is the best example of this microclimatic condition. On the other hand, the central area of the site is completely exposed with no available shelter. The southwest and northeast quadrants of the site have significantly more existing vegetation and can be observed to be subject to greater amounts of use. Areas of existing vegetation provide sheltered places during cold weather and shade in the summer.

The wind patterns on this site present a number of design opportunities. The human comfort range for wind speed reaches its maximum at 1.67 m/s (Olgay, 1992). Because of amount that the wind speed exceeds the human comfort range in Winnipeg, consideration of human comfort is important. Providing people using the site with shelter from the prevailing winds would help make the site more amenable to use. In addition to developing shelter from its force, wind can be used for cooling in the summer, the manipulation of snow in the winter and as a source of renewable energy.

3.5.2 Temperature

It is well known that Winnipeg is subject to an extreme temperature regime due mostly to its position in the centre of the continent and subsequent lack of a moderating body of water. Even during the seasons, large variations in temperature can occur. As a result, the need exists to capitalize on positive climatic elements, like the amount of sunlight received, in order to counteract the severeness of the climatic fluctuations.

Annual average temperatures were obtained from a meteorological station at the Winnipeg airport. These averages were based on 52 years of data from 1938 to 1990. The mean annual temperature was 2.4 °C (AES, 1993). Seasonal information is slightly more relevant when considering human comfort. Summer day time temperatures have been as high as 40 °C but average between 16 °C and 18 °C for the months of June to August. Research suggests that with regard to temperature, the human comfort range falls between 18 °C and 24 °C with and average of 22 °C (Olgay, 1992). It is a fairly easy conclusion that use of the site during the summer would be most comfortable.

3.5.3 Precipitation

From a design perspective, precipitation, in the form of both rain and snow, generates several concerns. The need for shelter from rain could become important depending on proposed changes in land use. Drainage is the second area of concern as many recreational land uses such as sports fields require good drainage to be functional. Snow is an important recreational resource and amounts are important for programming winter activities like cross country skiing or tobogganing.

From the perspective of remediation, precipitation wets the soil and minimizes dust emissions. This is important when working with a site with soil contamination. Moistening of the surface of the ground causes the soil particles to adhere to each other. Snow also mitigates erosion by covering the soil surface and protecting it from the wind (MacPlan, 1992). At a disturbed site, precipitation can also affect ambient pollution levels by removing gaseous and particulate pollutants from the atmosphere. This occurs when the pollutants are captured by droplets of moisture as they fall through the atmosphere (Stern, 1976).

Annual average precipitation data was obtained from three meteorological stations located in the Winnipeg area. These averages were based on 52 years of data from 1938 to 1990. The average number of days considered wet, because there was greater than 0.2 mm of total precipitation, averaged 119 days at these stations (AES, 1992). June is only slightly wetter than other months with 12 days of measurable precipitation. The maximum amount of rain to fall in a day was 83.8 mm in 1962 (AES, 1992).

3.5.4 Sunlight

Winnipeg receives 2377.3 hours of sunlight a year on average (AES, 1992). July receives the most with an average of 321.7 hours (AES, 1992). The great deal of sunlight can be used to mediate temperature extremes and expand the human comfort envelope. The amount of sun received in the

TABLE 2.2-1
ANNUAL PERCENTAGE DISTRIBUTION OF WIND SPEED AND DIRECTION
WINNIPEG METEOROLOGICAL STATION (1982-1991)

Wind Direction	Percent Distribution of Wind Speed and Direction Wind Speed (knots) 0-3	4-6	7-10	11-16	17-21	>21	Total	Mean Wind Speed (knots)	(m/s)
N	1.19	1.66	2.17	2.78	0.91	0.30	9.0	10.3	5.3
NNE	0.79	1.10	1.41	1.38	0.31	0.18	5.2	9.4	4.8
NE	0.57	0.94	0.95	0.65	0.16	0.03	3.3	8.1	4.2
ENE	0.47	0.72	0.64	0.36	0.06	0.01	2.2	7.2	3.7
E	0.50	0.83	0.97	0.65	0.12	0.01	3.1	8.1	4.2
ESE	0.35	0.71	0.95	0.77	0.11	0.02	2.9	8.7	4.5
SE	0.64	1.05	1.45	1.14	0.19	0.04	4.5	8.7	4.5
SSE	0.87	1.36	2.13	2.37	0.75	0.27	7.8	10.4	5.4
S	1.49	3.19	5.16	5.31	1.50	0.56	17.2	10.4	5.4
SSW	0.95	1.68	1.57	0.82	0.09	0.01	5.1	7.3	3.8
SW	0.77	1.14	0.95	0.44	0.07	0.00	3.4	6.9	3.6
WSW	0.82	1.43	1.26	0.59	0.10	0.01	4.2	7.1	3.7
W	1.38	2.54	3.40	1.50	0.30	0.07	9.2	7.9	4.1
WNW	0.97	2.16	2.48	1.58	0.44	0.15	7.8	8.8	4.5
NW	0.91	1.70	2.27	2.34	0.85	0.36	8.4	10.4	5.4
NNW	0.90	1.23	1.72	1.90	0.69	0.29	6.7	10.4	5.4
Total:	13.6	23.4	29.5	24.6	6.6	2.3	100.0	8.9	4.6

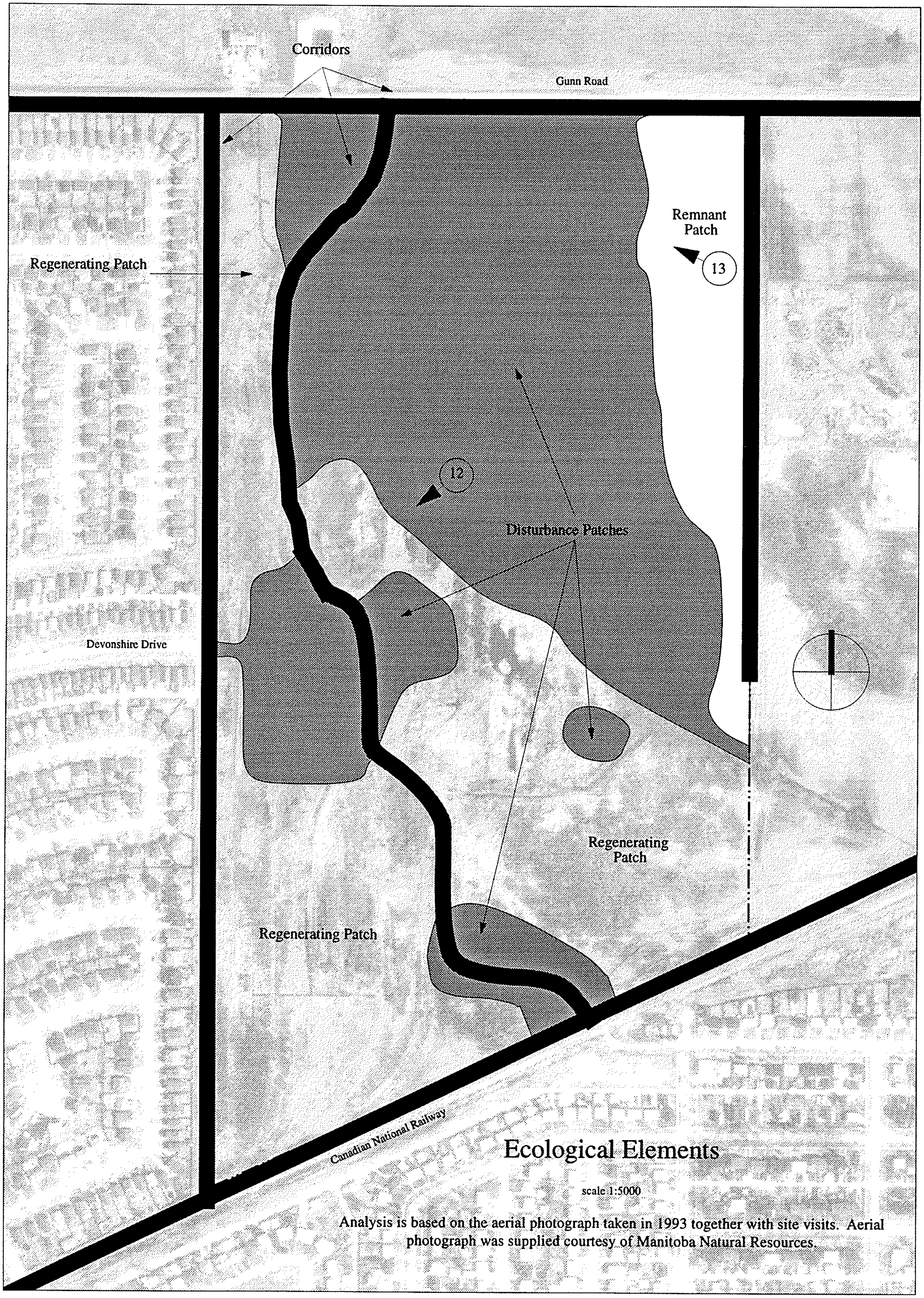
Top: A chart that shows the annual percentage distribution of wind speed and direction at the Winnipeg Meteorological Station from 1982 to 1991. Source: AES, 1992.

Bottom: A chart that shows the climate statistics at the Winnipeg Meteorological Station until 1982. Source: AES, 1992.

TABLE 2.2-4
CLIMATE IN WINNIPEG, MANITOBA

Parameter			Units	Meteorological Stations Winnipeg Airport	Winnipeg STP	Winnipeg St. Boniface
Temperature	Mean Daily Maximum	Annual Average	C	7.8	7.8	
		Minimum	C	-14.3	-14.2	
		Maximum	C	25.9	26.1	
	Mean Daily Minimum	Annual Average	C	-3.4	-2.7	
		Minimum	C	-24.2	-23.7	
		Maximum	C	13.3	14.3	
	Mean Daily	Annual Average	C	2.2	2.6	
		Minimum	C	-19.3	-19.0	
		Maximum	C	19.6	20.2	
	Extreme Maximum		C	40.6	37.0	
	Extreme Minimum		C	-45.0	-44.4	
Precipitation	Mean Rainfall	Annual Average	mm	411.0	368.0	395.3
	Mean Snowfall	Annual Average	cm	125.5	108.1	100.6
	Total Precipitation	Annual Average	mm	525.5	490.7	501.3
	Number of Days with Measurable Precipitation	Annual Average	days	120	98	90
Wind	Most Frequent Directions	Annual Average		S (14.5%) NW (10.0%)		
	Mean Wind Speed	Annual Average	km/hr	18.6		
	Maximum Hourly Speed		km/hr	89		
	Maximum Gust Speed		km/hr	129		

summer coupled with the high temperatures generates the need for shading devices for comfort. The days are long in the summer and the sun stays in the sky for a long time as it sets.


Corridors
Gunn Road
Remnant Patch
13
Regenerating Patch
12
Disturbance Patches
Devonshire Drive
Regenerating Patch
Regenerating Patch
Canadian National Railway
Ecological Elements
scale 1:5000
Analysis is based on the aerial photograph taken in 1993 together with site visits. Aerial photograph was supplied courtesy of Manitoba Natural Resources.

3.5.5 Summary of Design Implications

The site receives a large amount of sunlight throughout the year. The climate is harsh with extremes in precipitation and temperature both daily and seasonally. The winds blow primarily from the north to northwest quadrant and the south. Very little shelter currently exists on the site which makes it a relatively inhospitable area unless weather conditions are ideal for human comfort. In order to increase the useability of the site through the year, shelter needs to be developed either with vegetation or built structures.

3.6 Landscape Ecology

The ecological characterization of the Domtar site contains an identification of characteristic plant species as well as a discussion of ecosystem characteristics and dynamics.

3.6.1 Characteristic Plant Species

The current plant communities on the Domtar site are part of what is known as the aspen parkland. The aspen parkland forms a broad belt across the prairie provinces between the warm dry prairies to the south and the cooler moister boreal forest to the north. The species of the aspen parkland are outlined in a book by Derek Johnson entitled *Plants of the Western Boreal Forest and Aspen Parkland* (Johnson, 1995). In this book the three types of vegetative areas found on the Domtar site; marshes, grassland and groves of trees are described. Marshes are a specific type of wetland that are periodically inundated by standing water. Water that flows into these areas brings nutrients that in turn enrich the soil. The vegetation of marshes typically consists of reeds, rushes, sedges, or grasses (Johnson, 1995). The central area of the Domtar site is indicative of this type of habitat.

Facing: A plan diagram showing the ecological elements on the Domtar site. Sources: site visits by the author and an aerial photograph supplied by Manitoba Natural Resources.

In addition to marshes, the aspen parkland also consists of open grassland alternating with groves of trees. In the eastern parkland, within which most of Manitoba falls, the grassland areas are a tall grass prairie. Big blue stem (*Andropogon gerardi*), porcupine grass (*Stipa spartea*), and prairie cord grass (*Spartina pectinata*) will predominate given that the site has been free from intensive human disturbance. Typical tree species of the region will include primarily aspen (*Populus tremuloides*), but also bur oak

(*Quercus macrocarpa*), green ash (*Fraxinus pennsylvanica*), Manitoba maple (*Acer negundo*) and balsam poplar (*Populus balsamifera*) (Johnson, 1995). On the Domtar site the aspen is the predominant tree species at the present time.

3.6.2 Ecosystem Characteristics and Dynamics

In general, the ecosystem dynamics of the aspen parkland is one based on disturbance, usually by forest or grass fires. The plants of this area have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Facing: A view of the marsh located in the central section of the site. This area was once the location of the retention and evaporation ponds. Source: H. G. Brumpton, 1996.

Left: A view of the expanding edge of the treed areas in the northeastern corner of the site. This view also shows the an area of grassland typical to the aspen parkland region. Source: H. G. Brumpton, 1996.

developed adaptive strategies to respond to constant disturbance (Johnson, 1995). The ability of aspen to regenerate from their root systems is an example of an adaptation to periodic disturbance. As well, the native prairie grasses also have extensive root systems which have developed in part to help survive fire disturbance.

The landscape of the Domtar site can be analysed using landscape ecological elements. These elements are best described by Forman and Godron in their book *Landscape Ecology* (Forman and Godron, 1986). The Domtar site will be analysed using a spatial ordering system of patches and corridors set within a matrix.

Matrix

The matrix is considered to be the most extensive and most connected landscape element present, which also plays a predominant role in landscape functioning (Forman and Godron, 1986). The landscape element that meets these criteria is the residential communities and industrial areas that surround the site. The areas of private residences can be categorized as human habitation patches characterized by chronic disturbance and introduced species. The industrial areas to the north and northeast also fall into the same category of chronic disturbance. Therefore, the matrix is one of disturbance, which exhibits high heterogeneity. Using landscape ecology principles discussed by Forman and Godron, it can be inferred that the landscape will not have a substantial quantity of rare interior species present. It will have a large number of edge species and animals that require two or more landscape elements and an enhanced potential for total species coexistence. Flow of heat energy and biomass across boundaries separating patches, corridors, and matrix of a landscape increases with greater landscape heterogeneity (Forman and Godron, 1986). By facilitating an increase in landscape homogeneity, rarer species found only within the centre of patches would be given the opportunity to grow which would provide for interpretive activities to be supported. Patches with isodiametric shape, rather than narrow elongated shapes, would also facilitate the creation of more patch interior that acts as habitat for rarer species. Larger patches would also conserve biomass within the patch. Concurrently, areas of higher interior to edge ratios would also be useful for increasing species diversity. Patches that develop with a higher interior to edge ratio, that are essentially circular in form also have a low interaction with the matrix.

Patches

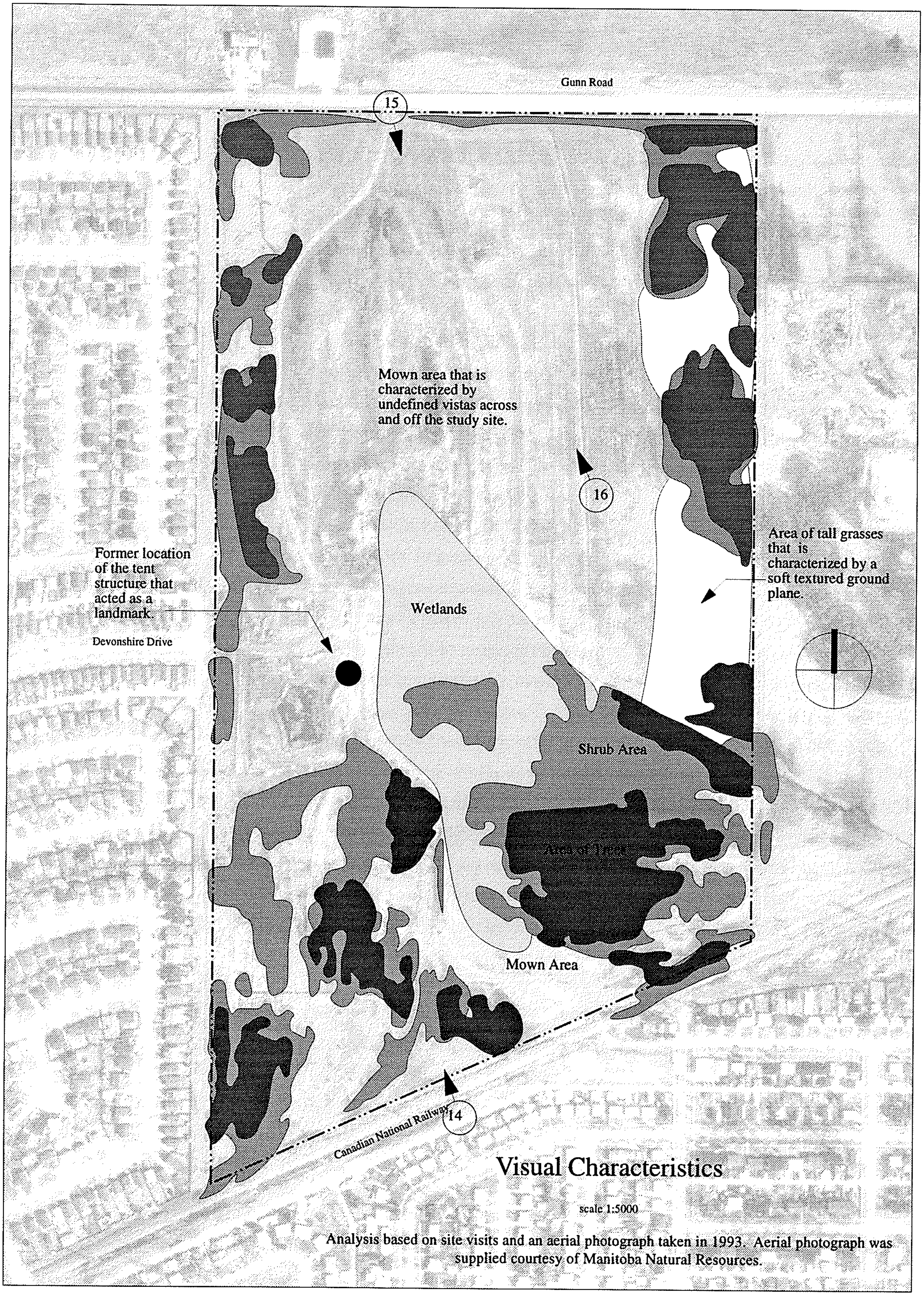
Three distinct types of ecological patches have been identified on the Domtar site. An ecological patch is a nonlinear surface area that differs from its surroundings (Forman and Godron, 1986). On the Domtar site, the most prominent patch type identified is a disturbance patch. An ecological disturbance can be defined as the event that causes a significant change from the normal pattern in an ecological system, while a disturbance patch is an area that has been disturbed within a matrix (Forman and Godron, 1986). Two areas of ecological disturbance have been identified on the site. The first is within the fenced area, the area that contains the highest level of contamination. The second area is within the north central area of the site which has undergone tilling and mowing. After an area is disturbed the population size of many species drops sharply, and in some cases local extinction occurs. Following is a drastic change in population size of the surviving species. Numbers of individuals within the remaining species increase, often more than compensating for the initial loss of individuals from species that did not survive. The next response is the colonization of the patch from species arriving from outside the patch. After these initial responses relative community stability within the patch area, at which point the patch will no longer be considered a disturbance patch (Forman and Godron, 1986).

Regenerating patches were the next type on the Domtar site. Regenerated patches are areas that become free of disturbance within a chronically disturbed matrix (Forman and Godron, 1986). Regenerating patches include those areas which have begun the process of regenerating after the treatment plant activities have been abandoned. These areas are located in the southern portion of the site. The succession process has begun within regenerating patches but relative community stability may not have been reached. The pattern of species dynamics through succession within a regenerating patch more closely resembles that of a disturbance patch.

The final patch type that exists on the Domtar site is a remnant patch. This patch type can be found in the northeastern portion of the site. Remnant patches are defined as an area remaining from a former large landscape element now surrounded by a disturbed patch (Forman and Godron, 1986). Air photographs of the site taken during the treatment plant's operation in 1968, show that activities on the site did not extend into this area. It can be assumed from ecological principles that this area of the site has continued farthest along in the successional process and could therefore contain sensitive interior species found nowhere else on the site. This would become an important resource of species that would facilitate migration of species into the rest of the site if properly connected.

Corridors

Several corridors exist in and around the site. An ecological corridor is a narrow strip of land that differs from the matrix on either side (Forman and Godron, 1986). The boundaries of the Domtar site are defined by corridors. The rail way and utility lines act as corridors, as does Gunn road and the Belevance Street right of way. The ditches that run to the north and south east of the site act as corridors as do the internal service roads. Corridors are important ecological features which help act as routes or conduits of movement. They also act as species filters and habitats for certain species (Forman and Godron, 1986). On the Domtar site the corridors present


Gunn Road
15
Mown area that is
characterized by
undefined vistas across
and off the study site.
16
Former location
of the tent
structure that
acted as a
landmark.
Devonshire Drive
Wetlands
Area of tall grasses
that is
characterized by a
soft textured ground
plane.
Shrub Area
Area of Trees
Mown Area
Canadian National Railway
14
Visual Characteristics
scale 1:5000
Analysis based on site visits and an aerial photograph taken in 1993. Aerial photograph was
supplied courtesy of Manitoba Natural Resources.

come as the result of ongoing disturbances, or maintenance. As a design implication, regenerative corridors can be designed to allow wildlife to move through the landscape.

3.6.3 Summary of Design Implications

The implications for design identified are not meant to be a restoration of the site to some previous state but rather to increase the variety of species found on the site by developing at least one isodiametric patch of vegetation. To quote Forman and Godron, "*a landscape with both many large patches, and a considerable length of edge around small patches and along corridors, will combine a wealth of sensitive interior species with edge species and wildlife*" (Forman and Godron, 1986). Building on this observation made by Forman and Godron, a large isodiametric patch could be developed on the Domtar site to provide habitat for rarer species that only flourish in the interior of large patches. By accomplishing this goal, the widest range of natural species will be available for interpretation, and will bring a sense of life back to the site.

3.7 Visual Characteristics

The analysis of the visual characteristics of the Domtar site has been organized around three main topics. The character and relationships of visual spaces and sequences is the first set, followed by an inventory of vistas, visual focal points or landmarks, and finally the quality and variation of light throughout the site.

Facing: A plan diagram that shows the location of the various vistas and focal points, views off the site and the unique visual spaces. Sources: site visits by the author and an aerial photograph supplied courtesy of Manitoba Natural Resources.

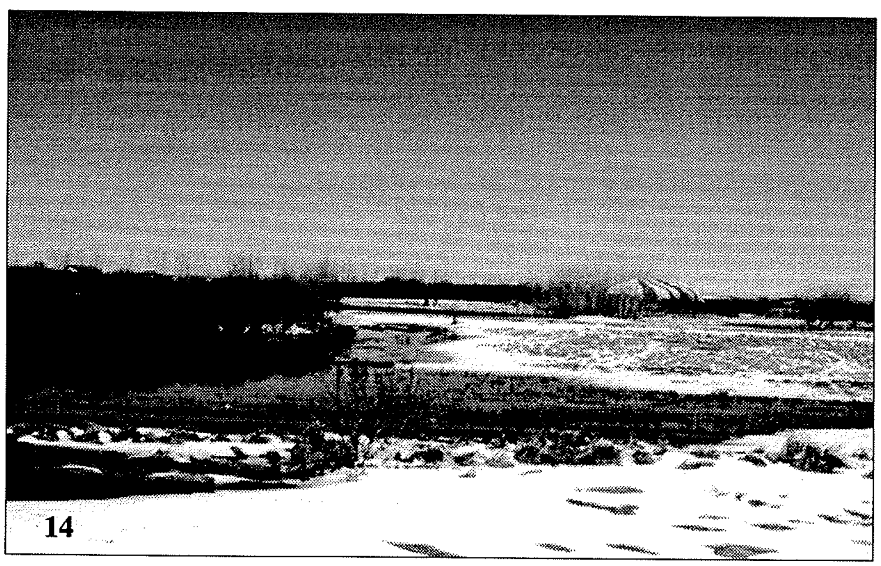
3.7.1 Character of Visual Spaces

In analysing the character and relationships of the visual spaces on the Domtar site, four areas were defined. These areas include the mown areas, an area of primarily tall grasses, the wetland areas, and the various patches of trees and shrubs. The mown area extends towards the north of the site. In this area, there is rugged and disturbed soil as a result of soil remediation procedures. The mown area is large and the views from within it blend its edges into the larger surroundings. Weak spatial definition is created through the horizontal, highly textured quality of the floor plane and the dome of the sky. This condition would be heightened in winter and spring when the leaves have left the trees.

Next, the areas defined as grassland consist of long, wild, growing prairie grasses. This area is bounded by trees to the east, the railway to the south, and residences to the west. This area has a two-dimensional character with a soft texture on the ground plane in the summer. In the winter, depending on the amount of snow cover, this area could still have an undulating ground plane as the tall grasses resist the weight of the snow. In the spring the tall grass areas maintain their soft texture.

The area defined as the wetlands is bordered by the grassland areas to the east, the railway to the south and Lakewood Meadows to the west. This is an area often containing standing water which is punctuated with stands of young trees and large shrubs. In the winter and spring, the contrast between the two-dimensional and three-dimensional components of this area creates limited framed views. In the summer and fall, when the bulrushes and other marsh plants have reached their peak size, views through this area are minimal given the height of the vegetation.

The wet areas of the south blend into the treed areas of the site. The patches of trees follow the site's boundaries up the west edge from the southern wet areas. These areas contain a combination of grassy texture on ground plane with the wild 'walls' of the trees and shrubs. The trees add a three-dimensional quality to the site and have begun to define it spatially. The beginnings of spatial definition caused by the forested areas of the site, generates a clearer sense of place for the Domtar site. Within the treed en-

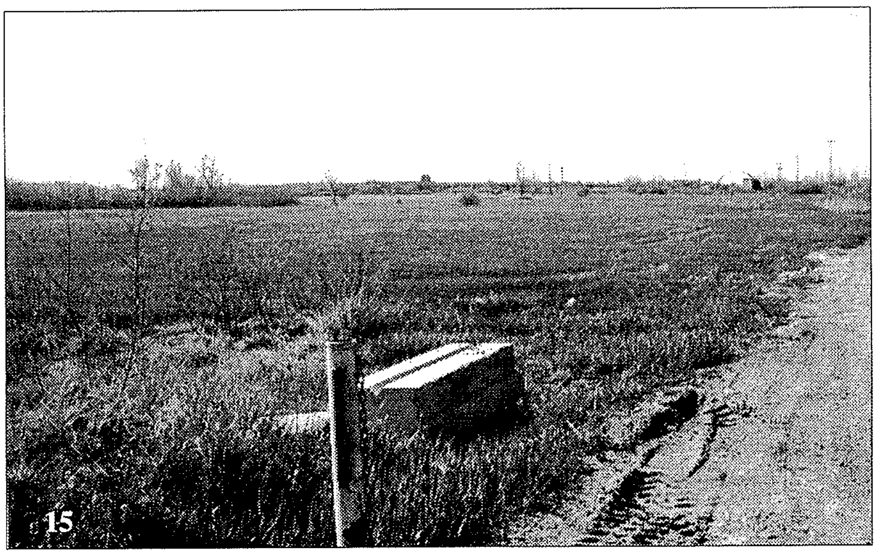


A view showing the tent structure used for the thermal desorption remediation technology as the primary site landmark. It has now been removed from the site. Source: H. G. Brumpton, 1996.

vironment as it currently exists, there is a loss of orientation to any outside landmarks, such as the utility towers. Small gathering spaces have developed in these areas. The scale of these sub-spaces is quite small and could even be considered intimate. The largest areas of trees are bounded by the north and east property lines and the grass area to the west.

3.7.2 Vistas and Focal Points

The vistas on the site are generated from the north central area. Looking north, a vista is interrupted by only the buildings being developed along Gunn Road. To the north west, the private residences can be seen through openings in the vegetation. Views off the site can be important design



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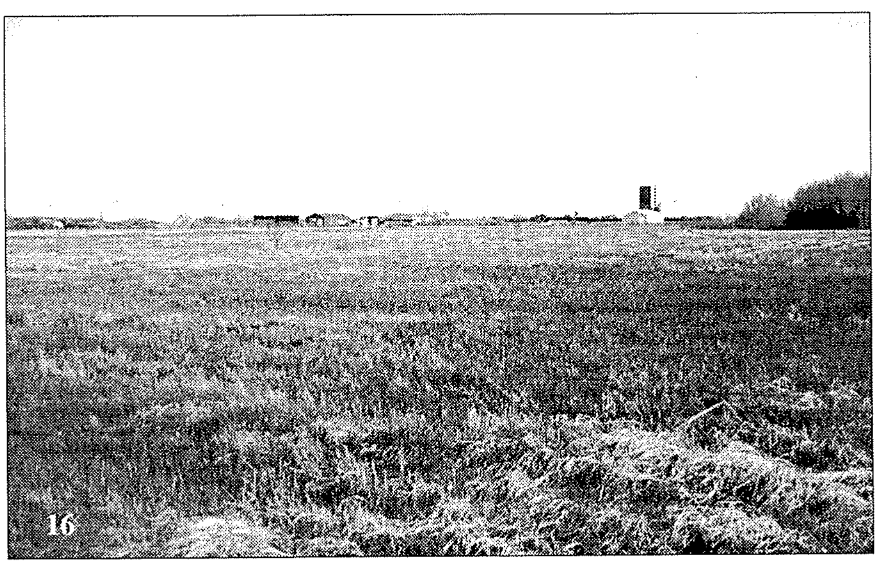
A view looking to the south east from the entrance to the site on Gunn Road. Source: H. G. Brumpton, 1996.



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A vista taken from the centre of the site looking north towards Gunn Road. Source: H. G. Brumpton, 1996.

devices for creating powerful experiences. The borrowed landscape is a tool that can be used to extend views off the site and into the horizon. Views of the site may also show that areas need to be buffered because they conflict with the set of desired experiences. Currently, the light industrial areas developing along the north edge of Gunn Road would conflict with an open space development focused on experiencing and interpreting natural processes. The open expanse of the site could be structured using vegetation to frame and capture long vistas within the open spaces of the site. The ability to view an open landscape from the edge of trees is a comforting experience often used as a device in the design of landscapes. Because of the irregular edges of the treed areas and the contrasting open expanses, the opportunity exists on this site to use this design principle extensively.

The landmark of the Domtar site is the large tent structure that is housing the thermal desorption remediation technology. The other equipment within the fenced area is also interesting but is not as visible as the tent structure from throughout the site. The site currently has no natural landmarks due mainly to its topography and lack of trees of significant size. As previously mentioned within the community survey section, a method by which the site could begin to be integrated with the community would be through the development of landmarks throughout the site. This would begin to allow people to perceive a spatial ordering system on the site which would make the site a more comfortable place to be than a similarly sized site with poor spatial definition.

3.7.3 Quality of Light

The quality of light can be grouped into two general conditions that occur throughout the site. In the summer and within the treed areas, sun light is filtered through the leaves of aspens. This makes for a pleasant condition. Outside of these areas the light conditions can be described as harsh. The light conditions can also be considered harsh in the late fall, winter, and early spring, as there is little shade cast by the trees because they have shed their leaves. During the sunset the quality of light improves somewhat as shadows develop from the trees. In order to improve the quality of the experience on this site variation of quality of light will need to be considered, most likely in conjunction with the development of some form of shelter.

3.7.4 Summary of Design Implications

The site currently suffers from poor spatial definition. Existing vistas are poorly defined focusing primarily to the north to the recently developed light industrial buildings. There is a wide variety of textures in the landscape that makes the experience of visiting the site more interesting. The variety of textures result from the diverse patches of vegetation. The light quality in the site is best within the groves of aspen but outside of these areas light can be harsh. Currently, the site's principal landmark is the tent structure housing the remediation technology.

3.8 Regulatory Issues

The final section of analysis addresses the regulatory issues surrounding changes in land use. There are two levels of government that have established regulations that govern land use on sites such as the Transcona Domtar site. The provincial government in Manitoba has recently developed the Contaminated Sites Remediation Act (Manitoba Environment, 1995). This Act is currently in the form of a discussion document issued by Manitoba Environment. In addition to the provincial regulations, the City of Winnipeg also has zoning regulations in place which will be considered as they apply to reuse design for the Transcona Domtar site.

3.8.1 Province of Manitoba

The Province of Manitoba has developed new legislation concerning contaminated site remediation. This legislation is based on guidelines developed through the Canadian Council of Ministers of the Environment (CCME). The CCME describes itself as; "*the major intergovernmental forum in Canada for discussion and joint action on environmental issues of national, international and global concern. The 13 member governments work as partners in developing nationally consistent environmental standards, practices and legislation*" (CCME, 1995b). The guidelines developed by the CCME are seen as advisory, meant to help provincial governments maintain some consistent standards at the national level, as well as facilitating discussion between provinces. They have come about mainly because environmental issues fall within the jurisdiction of both the Federal and Provincial Government. It should be noted that although it is an area of substantial ambiguity because of overlap in authority, the responsibility for administering contaminated sites has become the domain of the provincial government.

The central impetus behind the development of the provincial legislation, and the original CCME guidelines, came from issues surrounding liability for remediation. Lenders such as banks and trust companies are concerned that they will be found responsible for the remediation of sites that have been foreclosed. The Environment Minister's introductory statement in the draft of the legislation outlines the political issues well,

> *"lenders are concerned that they might be held responsible for expensive remediation of contamination on property acquired by virtue of mortgage foreclosure; remediation costs could far exceed the value of the property. Local governments are concerned that they might inherit liability where no other responsible party can be identified. Industry is concerned about the uncertainty surrounding these issues and how it could affect future financing, and we are all concerned that contaminated sites are dealt with promptly and effectively"* (Manitoba Environment, 1995).

From a political perspective, issues surrounding both land ethic and health and safety concerns are not articulated clearly within the previous quote. Even given the focus on liability in the Minister's introduction, there are several key areas of the proposed legislation that have some bearing on proposals for reuse design of a contaminated site.

The proposed provincial legislation contains 10 parts, the first two of which cover the interpretation of the Act and the investigation and process of identifying contaminated sites. Parts 3, 5, 6, 7 address responsibility, apportioning responsibility, cost recovery and appeals. Part 4 deals with remediation of contaminated sites specifically and is the chapter that has greatest relevance to reuse design as proposed for the Transcona Domtar site.

In Part 4 of the provincial legislation, section 15(2) addresses the director's ability to do two specific tasks. The first is to use consultants to help evaluate remediation proposals. The second is the ability to contact anyone who may be affected. This section essentially keeps the process as public as possible as it also mentions public hearings. Section 16(2) also has implications for reuse design as it outlines the remediation order and its contents. The remediation order "*may restrict or prohibit one or more uses of the site or of a product of substance derived from the site*" (Manitoba Environment, 1995). Further on, in Section 17, the legislation goes on to state remediation requirements. These requirements are outlined in the legislation in the following terms;

> *"In determining whether to issue a remediation order and the requirements of such an order, the director shall consider all relevant factors, including the risk to human health or the environment which the site or a contaminant of the site presents or might present; existing and planned uses of the site and nearby properties; the proximity of the site to residential and other areas regularly occupied by people, or sensitive or significant areas of the environment, as determined by the director; and the physical characteristics of the site"* (Manitoba Environment, 1995).

It can be seen that consideration of appropriate future land uses for contaminated sites falls well within the scope of a remediation order.

3.8.2 City of Winnipeg

The City of Winnipeg has control over future land use development on the Transcona Domtar site through its zoning bylaws. These bylaws are administered through the Land and Development Services Department. While Domtar's wood treatment plant operated from 1909 to 1976, the site was zoned as a Heavy Industrial District (M2). This designation allowed for a wide range of activities provided that no nuisance factor is created or emitted outside of an enclosed building (City of Winnipeg, 1994). This is the zoning designation of the sites to the north and east of the Domtar site.

Since the plant operations have ceased, the site has been rezoned as an Agricultural/Residential District (AR-5). The purpose of this designation is to permit small holdings of not less than five acres in order to accommodate limited residential uses and compatible agricultural uses (City of Winnipeg, 1994). The AR-5 designation sees a substantial range of permitted and conditional land use types as outlined in the City of Winnipeg bylaw 6400/94 (City of Winnipeg, 1994). The range of activities includes parks and playgrounds, golf courses, day care centres, schools, single family dwellings and crops such as fruits, grains, flowers or vegetables. The site's current designation does not permit manufacturing use.

An additional limitation stemming from the City of Winnipeg was outlined by David Nelson, the senior planner for the North Kildonan and Transcona areas. The Domtar site has been highlighted in Plan Winnipeg as originally it was slated to become a neighbourhood as the Lakeside Meadows development spread east. This took place prior to the extent of contamination being understood (City of Winnipeg, 1981). At present, any development proposal will only be given conditional approval until the site is deemed safe by the Province of Manitoba. The Province will issue the designation but the City of Winnipeg engineers will also evaluate it in the context of proposed reuse developments.

3.8.3 Summary of Design Implications

For reuse proposals to be implemented two layers of government need to be consulted. The City of Winnipeg, through the Land and Development Services Department, has specifically drawn attention to this site and made any proposed changes in land use conditional pending remediation. The provincial government's power lies within director's orders issued from the Department of the Environment. These orders are flexible enough so that they can be applied to the wide range of land use contexts found when dealing with contaminated sites.

3.9 Analysis Summary

Beginning with the site land use patterns and finishing with an examination of regulatory issues, the analysis of the Transcona Domtar site identified a series of design implications.

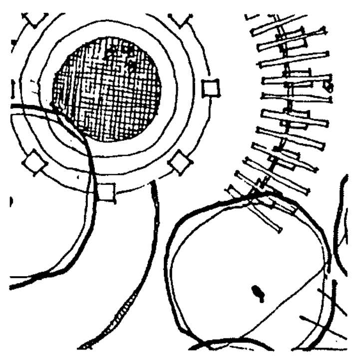
One of the most critical of the design implications to be identified is the need to address the historic dimension of the Transcona Domtar site. By addressing the history of the site through some aspect of the design learning can occur that will help us avoid this type of problem in the future. The second equally important design implication identified in the site analysis is the need to protect the integrity of the remediation works. This would include the capped areas and the secure containment cell. Breach of these works would subject visitors to the site to risk.

Strong use patterns on the site by adults and youth, even given its contaminated state, were identified from site visits and the community survey. This design implication emphasizes the need for development that takes into account the recreational needs of the community. Also derived from the community survey, more information is desired by the community concerning past, present and future activities on the site. The survey also showed that the community in interested in environmental issues and would support the development of a nature education facility.

Several constraints were identified with regard to the soil type and topography of the site. The site is quite flat and is subject to ponding in the spring and after periods of heavy rain. The soil is also unsuitable for development of recreational facilities such as sports fields. The drainage characteristics of the site would support a unique wet meadow habitat. This type of habitat is regenerating in the south portion of the site.

Finally, the site lacks shelter from weather extreme which make human use thought the seasons impractical. There were no significant landmarks identified and the site has poor spatial definition.

The design implications arising from the analysis have been combined with the implications identified within the study of precedents. Both of these sets of design implications have been carried forth into the next stage of the practicum, the development of a design proposal.



4

Design Proposal

The design proposal is built upon the design implications identified in the previous two chapters, the study of precedents and the site analysis. This chapter will address the components of the design proposal; the objectives of the design, the concept or ideas generating a framework for implementation of the design, the design program, and finally, the development of the design including a description of the relationship of each specific programmatic element to the conceptual framework.

4.1 Design Objectives

Many sites throughout our urban environment have been negatively impacted by past land use practices. These types of sites often pose health threats to the environment and to those people who either use the site or live adjacent to it. As was shown by the number and variety of precedents presented in the second chapter of this study, this is an emerging condition for which appropriate design responses have yet to be clearly established. With this in mind, the following two objectives set the tone for the design of the Transcona Domtar site.

The first objective is to have the design respond fully to the opportunities and constraints arising from the remediation and risk management proposals. Risk to the physical health of both the environment, and people as a result of the Transcona Domtar site, have been addressed through risk management and remediation programs developed by UMA Environmental. The proposal made by UMA is in itself not holistic in approach. The UMA proposal is a crucial facet of the proposed holistic process of healing the Transcona Domtar site. The design implications that have been identified in the analysis of the UMA proposal must be carefully considered in order to meet this objective. The design response outlined by this study is another facet of the healing process. It is important that the remediation and design responses be permitted to inform each other so that the breadth of the problem can be understood by everyone involved, and second, so that the best solution to the problems associated with the Transcona Domtar site can be found.

The second objective, which builds upon the first, is to address the needs of the community surrounding the site, specifically their healing process. This design objective deals with broader holistic health issues. Community health in a holistic sense has not been fully considered as part of the remediation process, as the focus of the consultants' reports have been specifically on the site's physical safety and the management of risk. While this focus has addressed the technical components required to make the site safer, it has not addressed all of the health issues surrounding the site, specifically the anxieties and concerns expressed by residents. This shortcoming was identified by Dr. Yassi, an independent health consultant who prepared a critique of the proposals made by UMA (Yassi, 1996). The shortcoming was also made obvious during the public presentation held on June 26, 1996, where a great deal of concern and frustration was expressed by the public to the proposals made by UMA. Broad holistic health issues, while helping form design objectives, have also helped form the design concept proposed in this study.

4.2 Design Concept

The design proposal is based on a series of ideas referred to as a design concept. These ideas have generated a framework for selecting a program of activities suitable for the site. This framework was then used to spatially arrange individual programmatic elements on the site. The ideas that define the framework for this design centre around notions of health, healing and holism.

Each of these related concepts has a distinct definition. In her critique of the UMA report Dr. Yassi gives the World Health Organization's definition of health which notes that; "*health is not simply the absence of disease but a state of complete physical, mental and social wellbeing*" (Yassi, 1996). This definition will be adopted for use in this proposal. The related concept of healing also generates a series of ideas that are relevant to the design. Healing can be defined as a return to a state of health (Avis, 1989). This idea has embedded within it the idea of the healing process, an evolution from one state to another that is better or improved. The final concept that will help guide decisions with respect to the design proposal is holism. Holism is a concept that is now more often being associated with health. Holism has been defined as the theory that a material object, especially a living organism, has a reality other and greater than the sum of its constituent parts (Avis, 1989). The theory conveys a sense of completeness, wholeness, or unity.

The conceptual notions of health were generated from several areas. The first is from design implications identified in the study of precedents and the site analysis. The concerns expressed by residents in the community survey taken in 1993 by students at the University of Manitoba (Weidemann, 1993), and at the public meeting held in the community on June 26, 1996, were the driving forces behind choice of health issues as the underlying concept for the design. The public's concerns in both cases focused on the uncertainty surrounding health issues and future land use options associated with the site. The concept of health was also discussed by Dr. Yassi in her critique of the remediation proposal presented by UMA in June of 1996 (Yassi, 1996). In this critique other health issues yet to be fully addressed by the UMA proposal were identified. One of these issues was the health of the ecosystem as a totality. The critique presented a holistic notion of health that expanded the types of human health issues that can be addressed concerning the Transcona Domtar site. Types of health issues, in addition to ecological health and the physical health of humans, that have been addressed in this design proposal include, the mental health issues of the residents surrounding the site and the social health issues arising from the relationships between business, industry, government and the residents.

Once the conceptual basis for the design proposal was established, research into precedents dealing with health and landscape architecture was undertaken. This led to a rich body of literature. Principles that helped guide the concept into form were identified. Topher Delany, quoted in *Healing Gardens* states from her experience that healing gardens; "*should have enclosed, connected rooms that provide a safe haven, and there should be lots of botanical complexity, but it should be ordered, not sloppy*" (Dannenmaier, 1995). The use of clarity of form, legibility, harmony, and some predictability through repetition in the landscape were also identified from these solutions. The use of diversity of experiences, specifically sensorial experiences was cited. Sensorial experiences can be accentuated through the use of texture, quality of light, colour and sound. The main difficulty in translating these principles into a design for the Domtar site involve the differences in scale. For the most part healing gardens are small enclosed courtyard scaled spaces. The method used to accomplish this translation is explained in greater detail in section 4.4.2 which describes the implementation of all of the programmatic elements.

4.3 Design Program

The program provides the designer with the appropriate level of information for initial design steps. In the case of an existing typology, such as a golf course or cemetery, the elements that constitute the program are more easily identified. In the case of a heavily disturbed site with residual contamination present as the result of past land use practises, a typical program of activities is not available or advisable. Therefore, the choice for the program of activities has partly evolved from the design implications identified by the study of precedents and the site analysis. The main activity that this site will be developed for is environmental education and interpretation.

The resident survey discussed in the site analysis has provided important information for the development of the program. A design implication that arose from the analysis of the survey data was that residents are concerned and want to know more about the activities on the site both past and present. Providing the opportunity for information about the past and present activities on the site to be disseminated and interpreted will promote awareness and understanding. Awareness can be used in the process of healing by reducing uncertainty and anxiety. Therefore it was seen as important that the predominant activity at the site will be interpretation.

In order for the interpretive activities to be successful, several key programmatic elements are required. The first is the ability to present information. It is also vital that the information be reliably accessible and understandable to visitors. In this proposal, information will be provided with an interpretive system. The node will act as the focal point of the interpretive functions of the park.

In addition to a central depot of information, clear access to the site for visitors and maintenance is required. Parking is also required for those visitors from outside the neighbourhood who may drive to the site.

The most important element required to support interpretive activities is material to interpret. In the case of the Transcona Domtar site, a great deal of material for interpretation already exists. The regenerative processes occurring with the site's vegetation is one prime example. Other material available for interpretation includes past land use including the remediation process, and wood treatment activities, rail history, as well as new land use patterns that may be developed on the site. New land use types proposed for the site that would be accessible for interpretation include manufacturing or commercial activities. Each of the programmatic requirements for the components of the interpretation activities are discussed in more detail below.

Regeneration

The first component of the interpretive activities proposed for the site is the regeneration of the site's vegetation and habitats. As mentioned previously regeneration is taking place on most of the site. In order to assist in the regeneration of the ecosystem on the site it would be helpful to conceive of part of the site as an round ecological patch. An isodiametric shape is roughly circular in form rather than elongated or sausage shaped. By structuring part of this site in such a way nutrients and energy would be conserved. This type of patch form would also provide habitat for rarer species thereby increasing the total diversity of the site. Greater biodiversity would allow for the opportunity to get a sense that life has returned to the site which would be good for healing negative perceptions. A variety of patch types would also be beneficial. By supporting meadow, forest and marsh types, a greater abundance of species would be present, thereby giving a greater sense of life to the site. A return of a diverse population of species would signify a sense the site is safer.

The impetus for this type of activity stems from the concept that nature has healing qualities in itself but it is also important to see nature returning to the site. This notion was the premise of Rachel and Stephen Kaplan's book The *Experience of Nature*. In it they state that; "*the brain seems both aroused and soothed by nature. It is as if the brain processes information from the natural world more smoothly than information from the built world, without having to undergo the stress of 'decoding' it*" (Kaplan, 1989). Another book which presents a similar position is *The Biophilia Hypothesis* edited by Edward Wilson and Stephen Kellert. In this book it is suggested that modern humans innately respond to natural content and configurations that characterize environments favourable to premodern humans (Kellert, 1993). These types of landscape would be one with open spaces and shelter. This type of spatial configuration presently exists on the site in the north west corner.

Remediation and Risk Management

The second component of the interpretive program is the past land use on the site. This aspect of the interpretation will encompass the remediation and risk management activities that have taken place on the site as well the operations of the wood treatment plant. In the case of the remediation activities, the programmatic elements required to make this facet of the interpretive activities work are in place. These would include the secure containment cell and other capped areas. Unfortunately no remnants of the treatment facilities are present which makes sharing information concerning the past more difficult. To handle this, panels with information on the types of activities that occurred as part of the treatment facilities will be part of the interpretive node on the site.

Manufacturing

The third component of the interpretive function proposed for the Transcona Domtar site are manufacturing activities. This type of activity will be defined in more detail in the next sections, but essentially light industrial, offices and other similar commercial functions would be located on a limited portion of the site. These activities would have to adhere to a tight description. They would be environmentally sensitive in their operations and would be on the site to showcase the latest in environmentally sensitive manufacturing processes and products.

The impetus for this type of activity has arisen from analysis of the surrounding land use patterns. On the north and east sides of the site various industrial activities are taking place. Given the sites's past land use was industrial, it was decided that a recycling of the past land uses would be appropriate given that controls and limitations are placed on industrial activities.

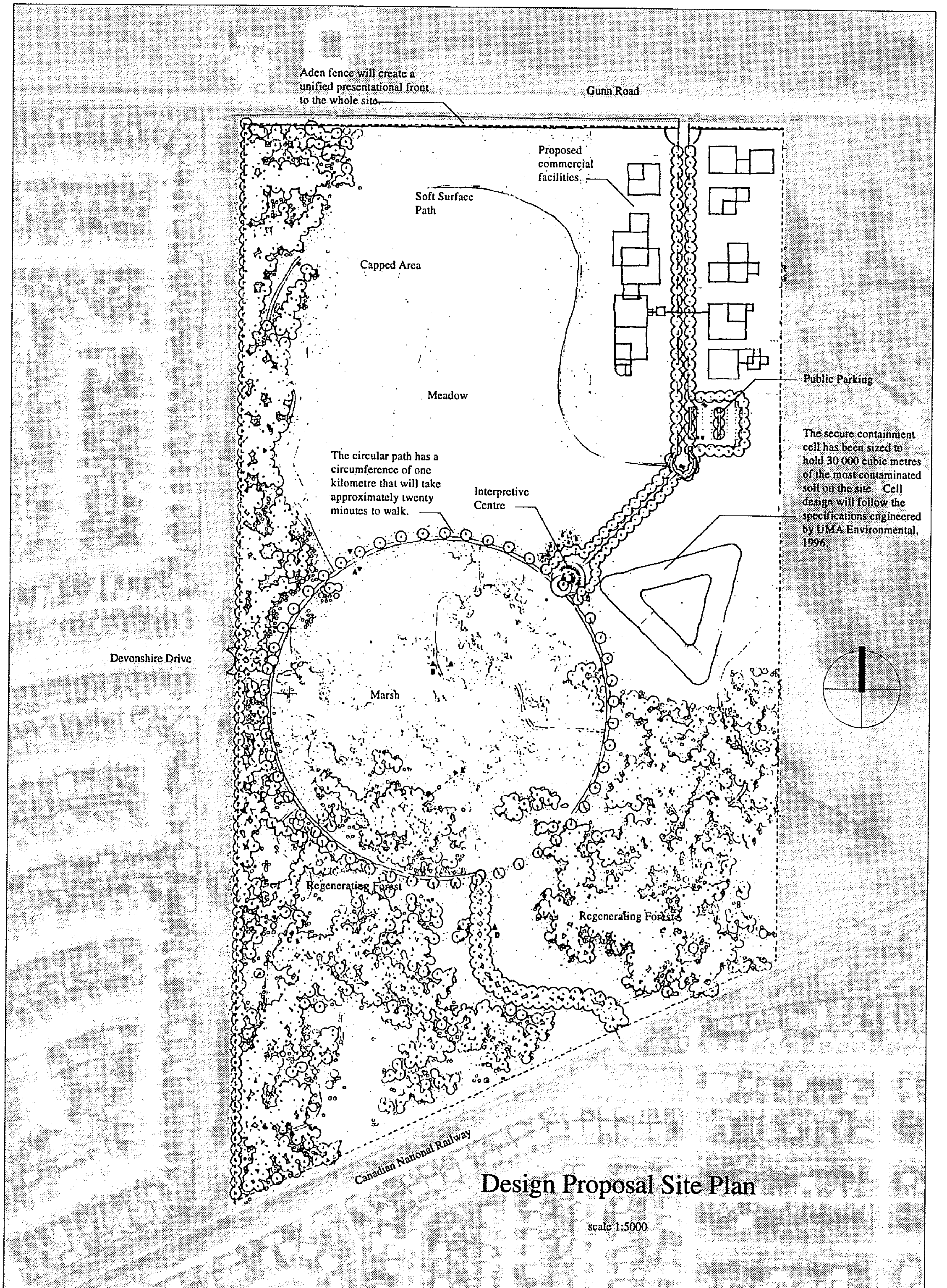
Various programmatic elements are required to support these types of activities. It is intended that with respect to city services that these facilities be as self-contained as possible. Parking for employees will be required as will loading areas for transporting products. Access to a main road other than Devonshire is also required.

4.4 Design Development

This section will address the spatial arrangement of the programmatic elements on the site. It will also address the relationship of the programmatic elements to the conceptual framework and to the functional requirements identified in the program. The section begins with a broad overview of the entire proposal and then focuses on individual parts.

4.4.1 Broad Overview of the Design Development

Healing gardens were used as a starting point to create form. A healing garden is a special type of garden that are sometimes developed near health care facilities. The intent of this type of garden is to promote healing. This type of garden The key difficulty in using healing gardens as a reference is the question of scale. For the most part, healing gardens tend to be small enclosed courtyards, while the Domtar site is much larger. It was found that the key design principles identified from healing gardens were able to be translated to the larger scale. The key design principles are a legible ordering system and ecological complexity.



Design Proposal Site Plan

scale 1:5000

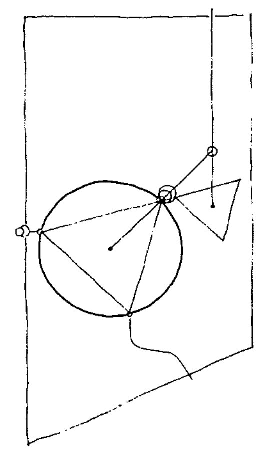
In order to increase the legibility of the landscape, a formal ordering system based on the geometry of a triangle and a circle was used. A circle was chosen to become the form for the main path on the site. It was chosen because the circle has strong symbolic meaning. It conveys a sense of holism as well as a sense of unity and completeness. The circle can also be read as a contrast to the complexity and uncertainty of the Domtar site at present.

The circle has been used in many cultures through history to create places of significance. Good examples are druid forms such as Stonehenge and the healing circle of the aboriginal cultures of North America. The circle was then carried throughout the design to provide a sense of unity. Examples of its continued use are in the intersections of the paths as well as the central interpretive area.

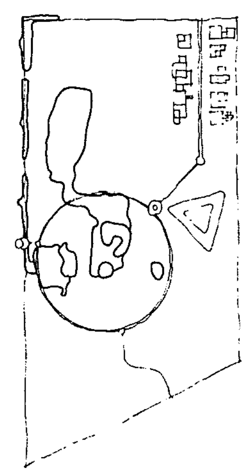
The circle which formed the basis of the main path through the site was inscribed with an equilateral triangle based on the intersection points of the entrance paths. An equilateral triangle was then translated out of the centre of the main path to become the shape of the secure containment cell. It was translated along an axis defined by the north edge of the inscribed triangle.

The road which enters the site from Gunn Road is the final geometric element. It is focused on the centre of the triangle that forms the secure containment cell.

In addition to principles of healing garden design, landscape ecological principles have been used to facilitate healing of the ecosystem on the site. As was identified in the ecological analysis, the regeneration of an isodiametric ecological patch is important. Isodiametric shapes at the scale of the Transcona Domtar site conserve energy and nutrient flows. They also provide potential habitat for rarer interior species. The southern portion of the site has been selected to regenerate naturally into the isodiametric form.



Geometric Organization



Residual Contamination

Facing: A plan of the entire site design proposal.

Above: Conceptual diagrams that describe the spatial organization of the site plan. The top diagram shows the geometric organization of the key elements and the bottom diagram shows the relationship of the key elements to the areas of residual contamination.

4.4.2 Detailed Overview of the Programmatic Elements

This section outlines specific elements that are used in the design as well as the placement of these elements on the site in response to the conceptual framework outlined above. The elements have been grouped into several categories that include: the edges, the circulation, the outdoor spaces, the landscape ecology, the remediation and risk management components, the manufacturing components, the construction process and the maintenance regimes.

4.4.2.1 Edge Conditions

As identified in the analysis, the site as it currently exists has strong perceptual boundaries created by roads, the Canadian National Railway line, and several sets of utility lines. These edge conditions are well established and impractical to change. The current edge conditions of the site contribute to its identity as separate from its context. By accentuating the independence of the site from the surrounding community, additional perceptual distance for those residents living nearby can be created. It is not the intent of the design to integrate the identity of the Transcona Domtar site with the identity of the larger community. It is felt that by providing a separate identity for the site, residents will be provided with the option of not acknowledging the site as part of their community.

West Edge

Two of the edges of the site will be developed. The western edge of the site, also designated as the Belevance Street right of way, faces the neighbourhood of Lakeside Meadows. The northern portion of this right of way will be impacted as part of the proposed remediation activities. After this area has been capped, It will be returned to a grassed area 15 metres in width running the length of the site.

North Edge

A wooden fence will run the length of the edge facing Gunn Road. It will be one metre in height and be designed in such a way as to have a strong presence on the landscape. The intent of the fence is to provide a unified front to the site. The north edge is the face, or front yard of the site. It is the side which is presented to visitors and so a good image is necessary.

4.4.2.2 Circulation

The circulation systems on the site can be categorized into five distinct types. The path types will form a clear hierarchy of path types that will increase the legibility of the landscape. This is important because by increasing the legibility of the landscape uncertainty is reduced for visitors. The structure of the pedestrian paths acknowledges existing desire lines across the site. As identified in the analysis chapter, the primary route across the site extends from the railway crossing in the south of the site to Devonshire Drive.

Road

A road is proposed for the site to support the commercial activities and allow access for visitors from outside the community. The road is proposed to be paved and have sidewalks and curbs. It will be lined with trees in order that it can act as a landmark and to provide shelter from the sun and wind. Trees will also strengthen the experience of moving down along the road. The road will enter the site from Gunn road and terminate in a cul-de-sac. Public parking will be provided at the end of the road for forty cars. The parking area will also be lined with trees to provide shade for the parked cars.

Entrance Paths

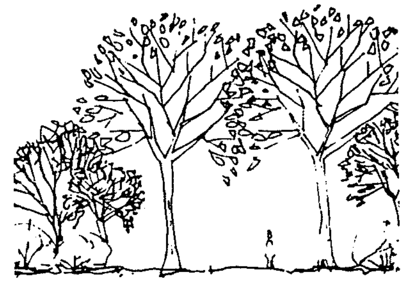
The next type of circulation are pedestrian paths entering the site from the railway crossing at the south, the west at the end of Devonshire, and from the cul-de-sac at the end of the proposed road. These paths will also be lined with trees similar to the road. Lining the paths with trees will increase the legibility of the landscape. The trees will also provide shelter from wind and sun. Views out from the paths will be framed by the tree trunks which will help to counteract the poor spatial definition that occurs on the site at present. These paths will be surfaced with asphalt.

Circular Path

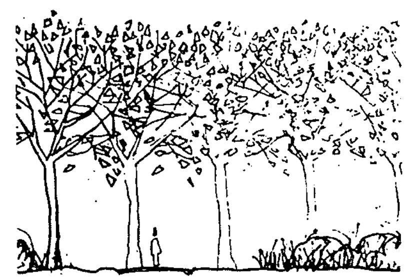
The main circular path will also be lined with trees. The spacing of the trees around the outside of the circle will be approximately 20 metres so that a more open experience can be attained. It is anticipated that most of the circle will be legible by a person on the path when the trees reach maturity. The circumference of the circular path is one kilometre. It will be surfaced with asphalt so that it can support activities such as in line skating, bicycling and use by wheelchairs. In order to maintain site drainage to the centre of the site, bridges or culverts will be required.

Floating Board Walk

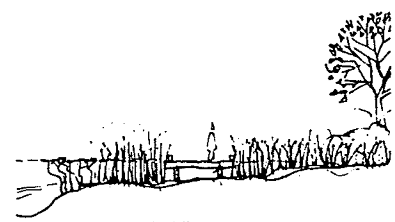
A path will enter the centre of the circle so that visitors can visit the marsh. Sections of this path will be designed to float. A system of floating board-



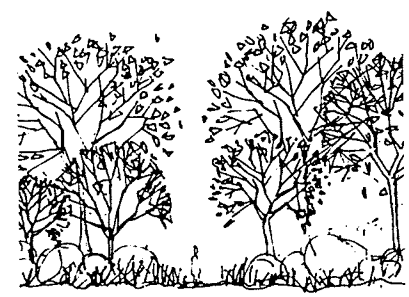
Entrance Path



Circular Path



Floating Board Walk



Soft Surface Path

Above: A series of images that depict the character of the different path types proposed.

walks will best respond to the fluctuating water levels that are anticipated in the marsh.

Soft Surface Paths

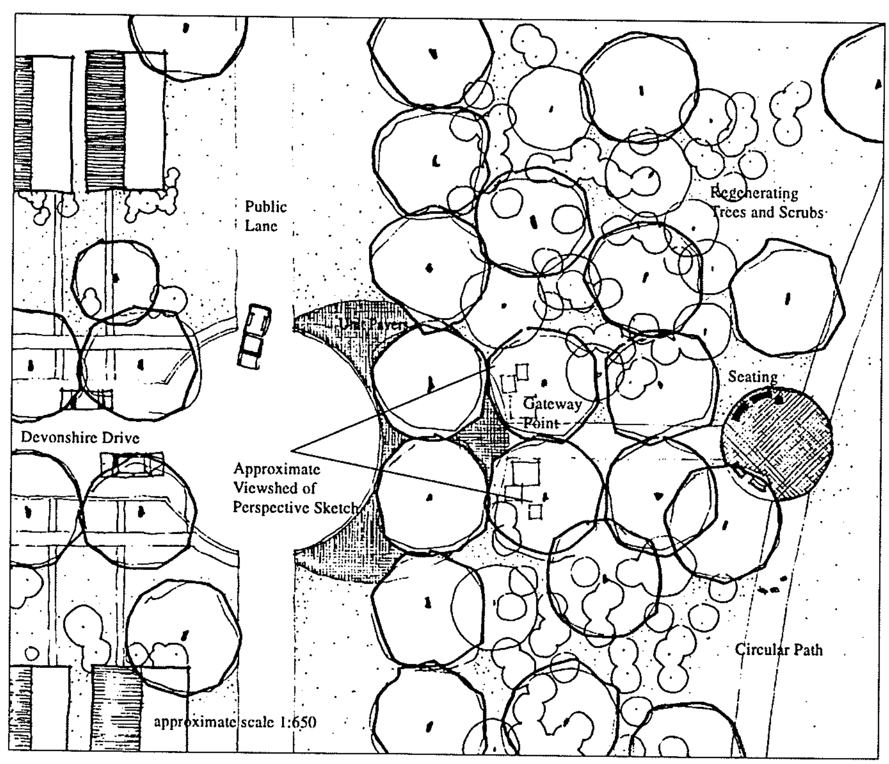
The final path type will be surfaced with bark mulch. These paths will be laid out in such a way as to contact the diversity of vegetative areas on the site. The soft surface paths will discourage in-line skating and cycling and will therefore help to create an experience most suitable for pedestrians. Bark mulch was also chosen because it an environmental benign material.

4.4.2.3 Outdoor Spaces

A series of outdoor spaces are proposed for the site. Overall, these spaces will be based on the circular geometry discussed in the broad overview of the proposal.

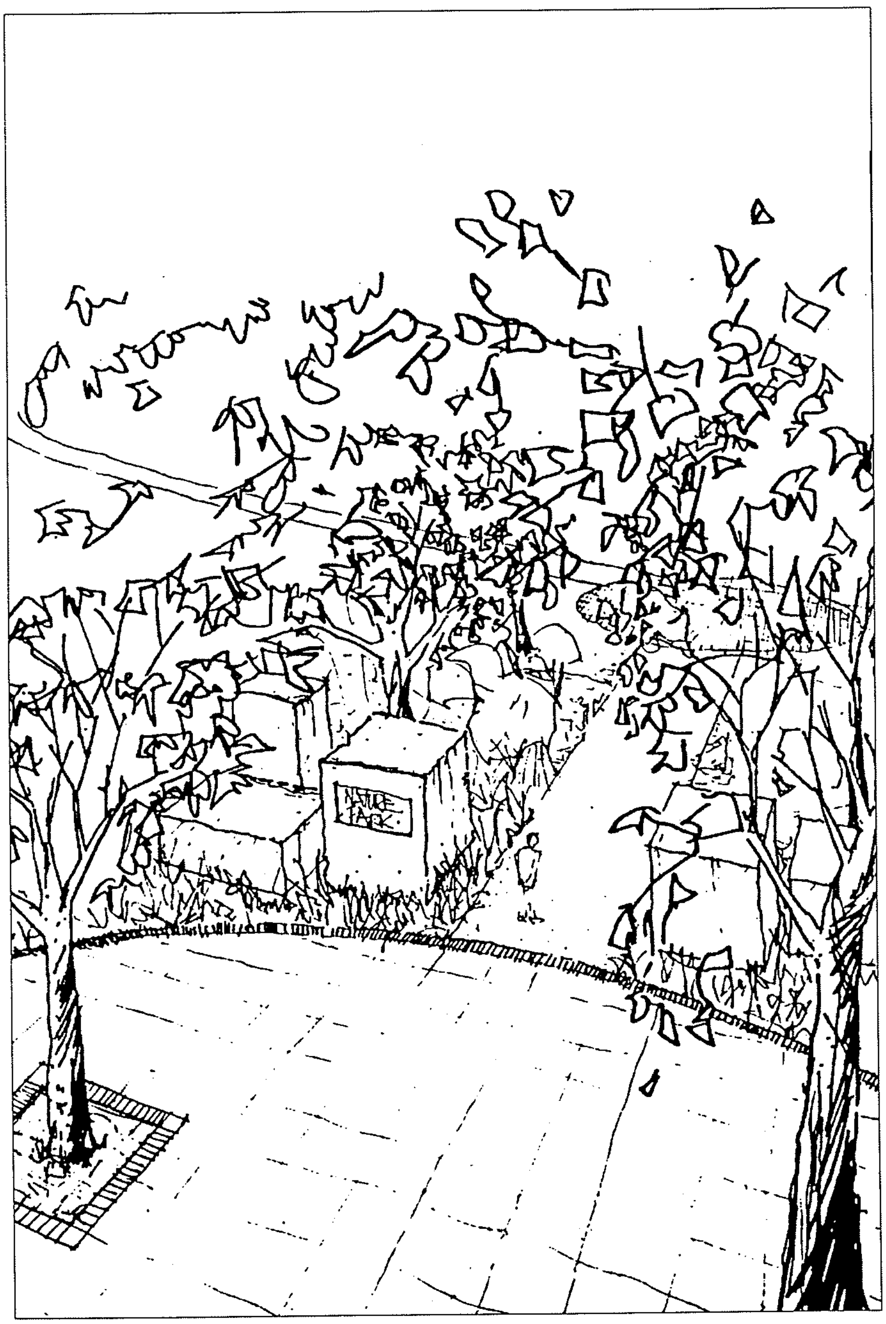
Intersections

The first type of space that will result from the emphasis of the intersections of the various path types. For example, when the paths connecting Devonshire drive and the circular path meet, an area will be defined with unit



A plan detail shows the character of the gateway to the study site at the end of Devonshire Drive.

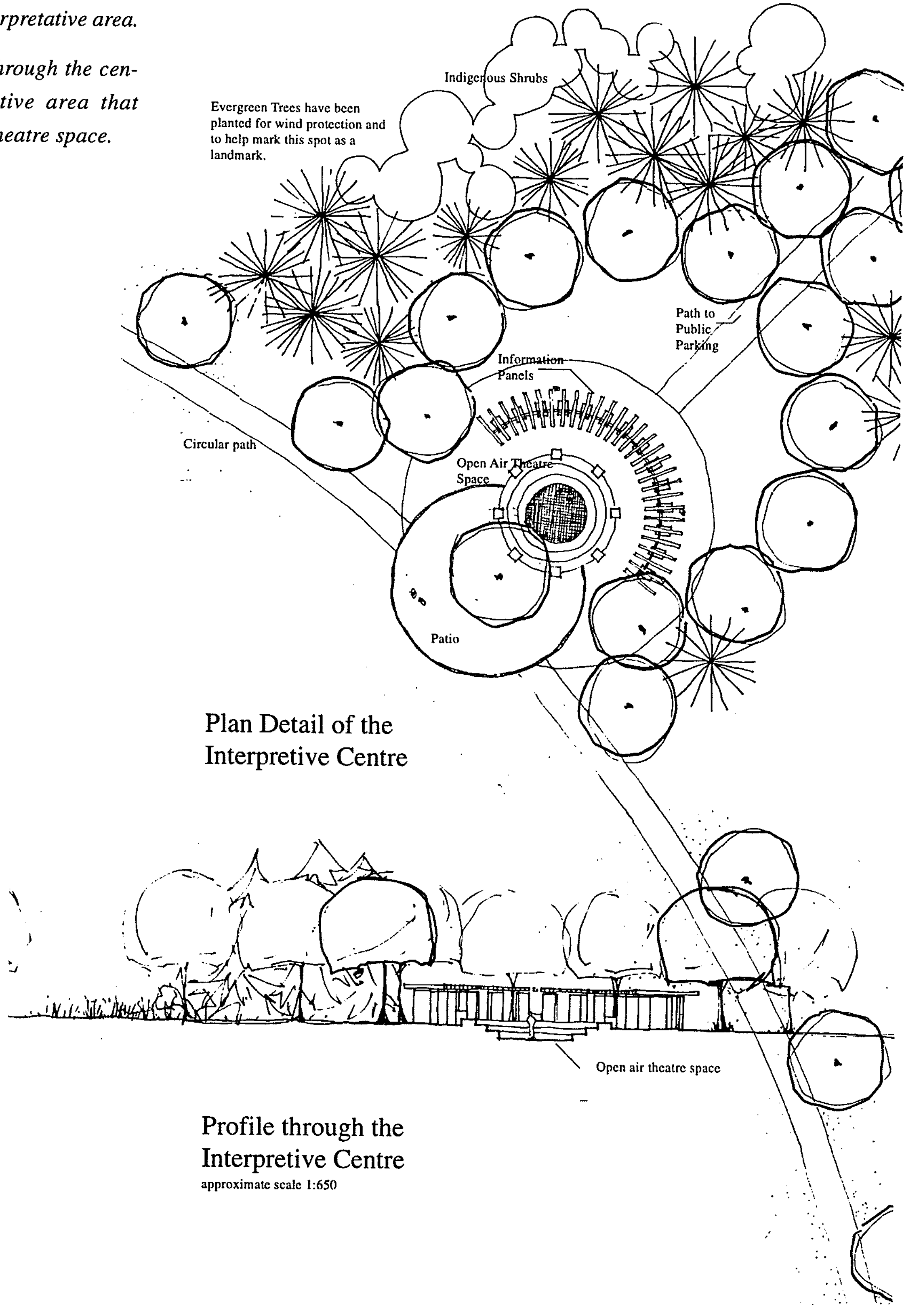
paving. Seating will also be provided. Accentuating path intersections will increase the legibility of the landscape. The shape of the intersections will be circular to reference the geometric theme that is carried throughout the proposal.



A perspective sketch that shows the character of the gateway onto the site from Devonshire Drive.

Top: A plan detail showing the configuration of the interpretative area.

Bottom: A profile through the centre of the interpretive area that shows the outdoor theatre space.



Plan Detail of the Interpretive Centre

Profile through the Interpretive Centre
approximate scale 1:650

Gateways

Entrances to the site will be developed as gateways in order to create strong thresholds to the site. Strong gateways will help to accentuate the independent nature of the site. The primary gateways to the site are located at the terminus of Devonshire Drive, the south entrance at the railway crossing, and where the proposed road enters the site from Gunn Road.

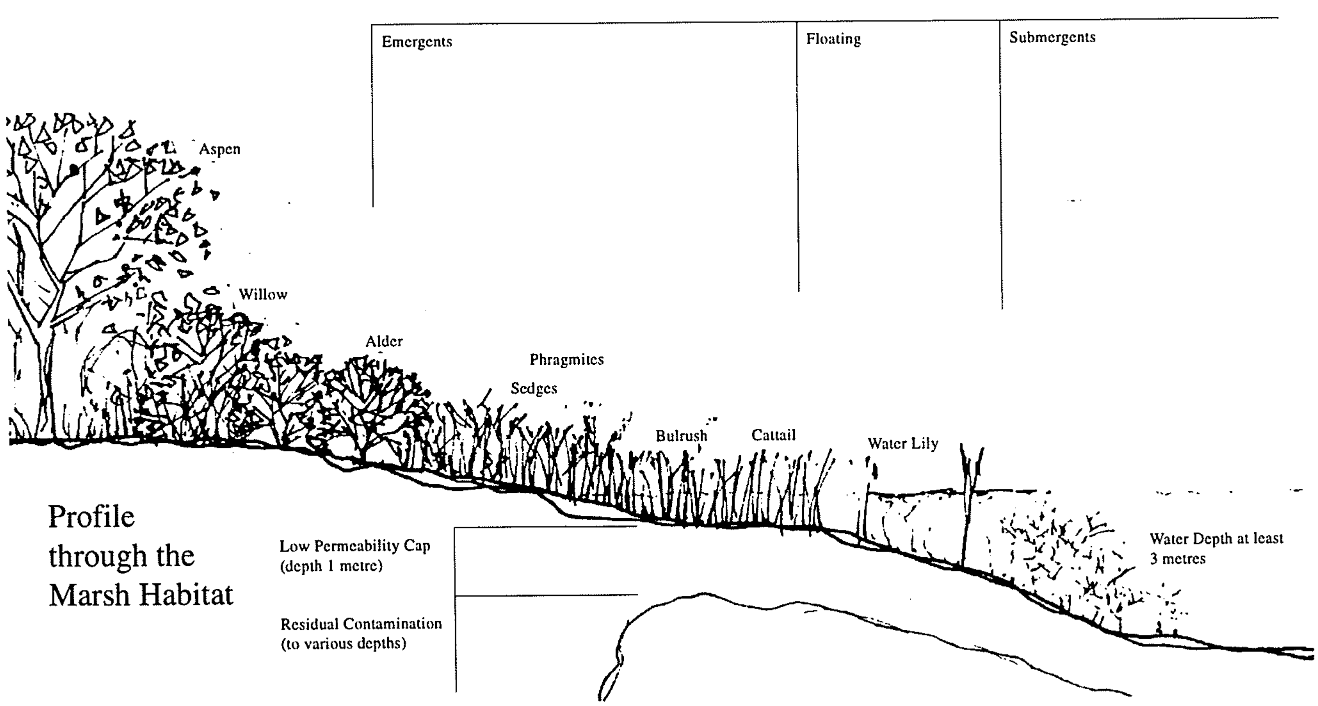
Each gateway will be marked with large pieces of limestone. The limestone will have a massive, permanent and stable character, similar to monoliths. Limestone was chosen because it is a material from the region.

At the Devonshire terminus, unit paving will be used to create a plaza-like space at the end of the street. The street will end in a circular cul-de-sac so vehicles can more easily turn around.

Interpretation Node

The interpretation node is the next outdoor space on the site. All of the information required to support the interpretive activities will be centralized at this point. This alternative was selected over having a series of panels scattered over the site because it was felt that a central location would have

A profile through the proposed marsh area showing typical species and the capped residual contamination beneath.



Profile through the Marsh Habitat

a stronger effect. It will also allow for all of the information to be accessed at once. Having this information in a central location also means that a visitor that wishes to use the site solely for recreation can do so without feeling as if she needs to confront the site's past land use.

The interpretive structure will relate to the gateways to the site principally through the use of similar materials, primarily rough finished limestone, wood and some steel. Limestone, as previously mentioned, has been chosen because it is an indigenous material. Wood was chosen because of its softer and more natural character. Wood also references the past land use on the site when wood was milled into railway ties. Steel will be used as an accent material because it references the railway which is an important part of the community of Transcona. The information concerning past and present land use activities will be contained on panels built into the structure. A circular theatre will also be part of this space. It has been sized for a class of school children to receive instruction. Seating will also be placed in this space.

The interpretive structure will become a landmark to help provide orientation and legibility to the site. Conifers will be used to provide shelter and to help define the spot as a landmark. Its form will be circular.

Natural Spaces

A series of natural spaces will result from the design and remediation proposals. The area that has been capped will be planted with wild flowers and grasses to become a meadow. This area will have a soft and colourful character.

The next natural area on the site can be described as the regenerating forest. This area will be located in the south portion of the site as well as along the west edge. Over time the character of the forest will change as trees begin to dominate shrubs. This area will have an enclosed feel with soft light penetrating through the tree canopy. Along the edges of the forest, areas of prospect and refuge will be created as the soft surface paths meander throughout.

A marsh area will result in the central portions of the site. This area will contain a diverse community of species, including many forms of wildlife, many of which are currently present on the site. The number and variety of birds and other small mammals that will inhabit this area will give a sense that life has returned to the site.

4.4.2.5 Remediation and Risk Management Components

The remediation and risk management works on the site result in important opportunities. The first is a large earth work resulting from the construction of a secure containment cell, and the second is a large capped area with residual contamination below.

Secure Containment Cell

The secure containment cell is proposed to become an integrated feature of the site. At present such a proposition is unlikely to be accepted by the community as many residents will associate it with their long struggle to see the site remediated. Over time these negative feelings will gain new perspective. It would be unwise to pass the opportunity the cell provides to create topography on a flat landscape. The opportunities that the cell would provide for future generations include use as a vantage point allowing for views, a place for tobogganing and other active play by children.

The containment cell will also be an important part of the interpretive functions of the site. Interpretation of the secure containment cell will occur through the use of panels within the interpretive structure.

The form chosen for the cell is an equilateral triangle. The shape was generated in three ways. The triangle is a clear geometric form which relates to the use of clear legible forms, but unlike the circle it is different, having less comfortable connotations. The intersections of the entrance paths as they meet the circular walk is based on an inscribed triangle. This form was transcribed to the east. The aesthetics of earthworks was also discussed by Hackett in the book *Landscape Reclamation Practice*. In it, the virtues of geometric and natural earth forms are debated. Hackett's conclusion is that constructed earth forms should relate to the natural earth forms that exist in the region (University of Newcastle, 1971 and Hackett, 1977). Unfortunately, the case of the Domtar site, the existing land form is flat so that any earth form constructed would be read as unnatural. Therefore, the use of geometric earth forms are felt to be more appropriate than a synthetic natural earth form.

The design of the profile of the cell to keep the contaminated material secure would follow the work done by UMA Environmental. The proposed position of the cell on the east edge of the site would allow for it to expanded to hold more highly impacted soil. It would also be accessible for future inspection and maintenance.

Capped Areas

The capped areas on the site will receive to treatments in this proposal. Areas in the central portion of the site with the greatest levels of contamination will be excavated to depths great enough to allow for sufficient capping and two allow for the topography to be shaped in such a way as to allow for water to collect. This would allow for marsh species to develop. The saturated soil conditions that would result in this case would help keep the cap from drying and cracking.

Areas outside of the central portions of the site will not be excavated. These areas will be capped with low permeability soil as specified in the engineers' report. Plant material will be controlled with periodic mowing.

4.4.2.6 Manufacturing Component

The second major feature proposed for the site is a reintroduction of manufacturing activities. Similar to Gas Works Park, previously discussed as a design precedent, the manufacturing activities would provide an opportunity for interpretation. Unlike Gas Works Park, the manufacturing facilities would be more than a just sculptural element. The manufacturing activities proposed would become a productive land use as well as a sculptural element and an interpretive opportunity.

The businesses accepted for the site would be ones that could exhibit environmentally sensitive operations, through use of an industrial ecological approach. Industrial ecology, as defined by Graedel, is an approach to the design of industrial products and processes that evaluates such activities through the dual perspectives of product competitiveness and environmental interactions (Graedel, 1995). A manufacturing facility in Winnipeg that exhibits this approach to its operations in Acrylon Plastics. This industry manufactures plastics products from recycled materials. They also monitor waste products and energy consumption.

The use of a site disturbed by past manufacturing land use to showcase contemporary manufacturing activities will strengthen the interpretive experience. Showing that industry can be a positive component of the community and that industry's relationship to the environment has also evolved for the better since the time of the wood preservation facility is an opportunity on this site. The juxtaposition of the contaminated land and the reformed industry will strengthen the intent.

The location of the manufacturing activities has been focused in the northeast area of the site. This placement will allow for the greatest amount of buffer to be established between private residences and the manufacturing facilities. It also allows the manufacturing facilities to be positioned in proximity to similar facilities located off of the site. The northeast area has not been disturbed and contains moderate ecological value. The moderate ecological value of the area in the northeast balanced against the importance of providing an adequate buffer space between commercial activities and private residences was a difficult decision.

From a conceptual standpoint, commercial activity fits with the notions of health, healing and holism. By having the commercial activities available for interpretation, the social healing could be facilitated. Visitors to the site would be able to see how technology has been applied to avoid the problems of the past.

4.4.2.6 Drainage

Site drainage will be developed so that runoff is focused into the central portion of the site. This will allow for a marsh habitat to develop and sustain itself. Water levels are expected to fluctuate based on the season. An overflow ditch is proposed to handle instances of high runoff. This ditch would run parallel to the existing ditch running north to Gunn Road. A parallel alignment is preferred so that the ditch will not drain over the capped areas. Drainage could promote erosion and affect the continuity of the caps. By developing a new ditch in this area, the existing ditch will not have to be excavated, thus reducing the risk of generating air emissions during excavation of contaminated soil. The ditch will have a more natural, meandering form. This type of form will reduce long term erosion by reducing flow rates.

4.4.2.7 Maintenance

This proposal has low maintenance requirements. Maintenance that is required will not be much greater than what is required to maintain the remediation works. Periodic mowing of capped areas will be required to keep trees from invading.

Another area which may require maintenance are the fence across the north end of the site. Maintenance of the trees planted on the site will also be required in order that they can establish properly. The soft surface paths will need to be resurfaced periodically as the bark mulch will biodegrade over time.

Long term control of the maintenance of the site will be the responsibility of the manufacturing facilities on the site. Costs of maintenance can be part of the incentives granted to these facilities. The maintenance of the site by the businesses located there will be seen as stewardship, showing that business is capable of caring for the environment.

4.5 Design Proposal Summary

This chapter began by stating the objectives for the design. The design was to respond to the opportunities and constraints provided remediation proposals. The design proposal was also to respond to the needs of the residents surrounding the site, specifically holistic health issues. The design objectives were followed by a discussion of the ideas that were used to develop an appropriate program of activities, and to guide the placement of those activities, on the site. These ideas were focused on health, healing and holism. The chapter concluded with a broad and detailed overview of the elements of the design.

5

Study Summary

This practicum endeavoured to explore the issues surrounding an urban site heavily disturbed by past land use. The Transcona Domtar site was identified as a contaminated site under pressure for reuse development. This pressure for reuse development stems from the proximity of private residences built before the extent to which the risks associated with the site's condition had been understood. The extent to which the site has been impacted by past land use has subsequently become clearer as the methods and technology for characterizing contaminated sites has evolved. Remediation strategies based on ever clearer understanding of the extent of impact have been implemented on the site with unsatisfactory results.

In the search for an appropriate design response for the study site, precedents were examined in order to identified a range of design responses to highly disturbed and contaminated sites. The site analysis followed the study of precedents. It generated a series of design implications to inform the development of design proposal, specifically the concept and the program. The concept, which was used for implementing the various programmatic elements, centres around health issues. Programmatically, the focus of the proposal is on environmental education and interpretation which will allow the linking of the remediation and risk management activities, the commercial activities and the regeneration of the site's ecology. The proposed program allows the stated objective of healing people's perceptions of the site to be attained. This will occur because the opportunity for residents of the area to increase their awareness of past, present and future activities on the study site will be provided.

Future work could be undertaken in regard to the Transcona Domtar site. A more representative system of community consultation needs to be developed. This would allow for a greater and more reliable sense of community concerns to be obtained. In addition, a more detailed examination of incentives that could be put in place to encourage commercial development on highly impacted sites would be worthwhile. A risk analysis study that examines impact on the ecosystem as a whole would also contribute to finding and implementing an appropriate design solution.

Several problems were confronted during the preparation of this study. The first was the lack of a technology that could be used to separate the contaminants from the soil. This situation meant that a significant number of technical constraints existed. The technical constraints arose from the requirements surrounding the maintenance and placement of the engineered caps and the secure containment cell. Another area of difficulty was the evolution of knowledge that is occurring in regard to this type of site. Greater understanding of the contaminants and their environmental fates, procedures for analysing risk and the potential technologies that could be used for remediation is continuously increasing. Knowledge in these fields has increased significantly in the time during which a technical solution has been sought for the Transcona Domtar site.

In conclusion, an appropriate design proposal that provides the opportunity for increased awareness and understanding to be acquired will contribute to a healing process required to bring a state of health to the Transcona Domtar site and surrounding community.

Appendices

Appendix A: Characterisitics of the Contaminants

There were two wood preserving chemicals used at the Transcona Domtar site: creosote and pentachlorophenol. Both of these chemicals are solutions of various component chemicals that in turn have different sources, uses, and background levels in the environment.

Creosote

Creosote was used for the longest period of time at this site. It is a distillate of coal tar produced by high temperature carbonization of bituminous coal. Creosote is a dark brown oily liquid and consists principally of liquid and solid aromatic hydrocarbons and also contains some tar acids and bases. It is heavier than water (MacPlan, 1992).

Creosote is a mixture of more than 200 compounds, with the majority of the common compounds being polyaromatic hydrocarbons (PAH's). The complicating issue in the composition of creosote is that the amount of the various parts can vary widely depending on the source of the creosote.

As a result of synthesis by some plants, and by forest and grass fire, PAH's occur naturally in the environment. The greatest amount of PAH's in the environment come as a result of the combustion of fossil fuels. Other uses for creosote include use in roof pitch, fuel oil, lamp black, and as a lubricant in die moulds. PAH's are used in a variety of manufacturing processes including dye and plastics, and insecticides, herbicides, fungicides and explosives production. They are found in the emissions and waste water from these types of manufacturing processes.

It is believed that PAH's are widely distributed in the environment (Eisler, 1987). They are usually detected in animal and plant tissues, sediments, soils, air, surface water, drinking water, industrial effluents, ambient river water, ground water. Sites nearer to urban centres have a much higher PAH deposit level than rural areas.

Pentachlorophenol

The second type of wood preservative used at the Transcona site is called pentachlorophenol (PCP). In its pure form, PCP is a white, solid, aromatic compound, synthesized from phenol and chlorine (University of Akron, 1996). The PCP used by the wood treatment industry differs from the purest form in that it contains 10 percent other chlorophenols and related compounds and 4 percent inert compounds (Environment Canada, 1988).

The use of PCP was first used as a wood preservative in 1936 (Richardson, 1978). Its use is as an antimicrobial agent in industrial cooling systems and papermaking, and as a fungicide in protein-based latex paints (Jones, 1981). A 1981 survey of PCP use in Canada revealed that the wood treatment industry was the largest use of PCP consuming 1536 metric tonnes or 96 percent of the total Canadian consumption (Jones, 1984). PCP has not been manufactured in Canada since 1983. Currently Canadian users have been supplied by either of the two European manufacturers or the single American manufacturer (MacPlan, 1992).

PCP is not a natural compound and its environmental background level should be zero. However, anthropogenic sources (human) have resulted in trace concentrations even in very remote locations. It has been detected in winter snow packs, water, landfill leachates, sewage effluents, sediments, and in aquatic and terrestrial organisms. Many sources of PCP releases into the environment include the following; disposal areas used for various commercial formulations used historically as fungicides, storage areas for PCP treated products, which would primarily be lumber, accidental or uncontrolled process releases from wood treatment facilities, and chlorinated waste water, especially those from pulp and paper mills and municipal sewage treatment plants (MacPlan, 1992).

At low concentrations, PCP is not considered a persistent contaminant in the environment because of documented photochemical degradation and microbial breakdown in surface waters, soil media, and sewage effluents. However, PCP is widespread at low concentrations in the environment, indicating that the above conclusions are not universal, or that input rates exceed those of degradation. The environmental effects would be dependent upon a complex array of parameters including concentrations, pH of environmental media, adsorption to suspended solids, temperature, biodegradation rates, and photodecomposition rates (MacPlan, 1992).

Appendix B: Wood Treatment Processes Utilized

During the Transcona Domtar plant's operation, two techniques for introducing the preservatives to the wood were used on the Transcona site. These are outlined in the 1993 draft consultant's report (MacPlan, 1992).

Full Cell Process

The full cell process was used when the wood product needed a higher retention of preservative. This process resulted in the cells of the wood being filled to capacity with the preservative. The steps of this process are as follows;

- Load cylinder and seal the door.
- Apply vacuum to remove air from the wood cells.
- Maintain vacuum and introduce preservative until the cylinder is completely filled.
- Apply pressure to force preservative into the wood. The rate and amount of preservative absorption is determined by continuous storage tank inventory and measurement.
- Release pressure slowly to atmospheric.
- Transfer preservative solution from the treatment cylinder to the storage tank.
- Apply a short final vacuum to clean wood surfaces.

Empty Cell Process

The second type of technique used was called the empty cell process and it has two different variations. In both cases pressurized air is used to force out excess preservative from the wood. The object of these two processes is to obtain deep penetration into the wood with relatively low retention of the preservative. The first of the empty cell processes is called the Lowry process and its steps are as follows;

- Load cylinder and seal the door.

- Introduce preservative at atmospheric pressure until the cylinder is filled.
- Apply pressure to force preservative into the wood to the desired level of absorption.
- Release pressure slowly to atmospheric.
- Transfer preservative solution from the treatment cylinder to the storage tank.
- Apply a short final vacuum to clean wood surfaces.

The second variation on the empty cell technique was called the Rueping Process. Its steps consist of the following;

- Load cylinder and seal the door.
- Apply pressure to fill the wood cells with air.
- Maintain pressure and introduce preservative to the cylinder until it is completely filled.
- Increase pressure to force preservative into the wood and further compress the preliminary air until the desired absorption is achieved.
- Release pressure slowly to atmospheric.
- Transfer preservative solution from the treatment cylinder to the storage tank.
- Apply a short final vacuum to clean wood surfaces.

Appendix C: Extent of Contamination

Two consultants' reports have been used to compile this appendix. The consultant's draft report submitted to the Ministry of the Environment in December of 1992 (MacPlan 1992) and the plan developed in 1996 by UMA Engineering (UMA, 1996). The sampling on this site has occurred because the generation of a risk analysis relies on it for its soundness. Sampling and monitoring are ongoing, and is now been managed by UMA Engineering. The description of the extent of contamination has been provided because it gives a sense of the level of impact the environment has withstood both by the wood treatment plant and subsequent remediation procedures.

Soil

Sampling of the soil on this site has taken place from 1976. The initial emphasis of the sampling has occurred in what has been described as area A, or the location of the pressure cylinders. This area is now fenced. The conclusion of the sampling in June of 1993 was that this area had the highest levels of contamination. The levels of contamination were next highest in area B which is where the evaporation pond was located.

Some consideration has been given to the range between values of the samples. This has been attributed to different laboratory analysis techniques but it is felt by the consultants that; "*the extent demonstrates that a true range of contamination levels is present on the site which are attributable to other factors such as operating practices and accidental spills*" (MacPlan, 1992). More sampling occurred in 1986 in an attempt to better define the contamination in area A. This set of samples indicated that soil contamination existed at depths of 11.6 metres (Cherry and Smith 1987). Sampling has also indicated that the contamination is localized to within area A and has exhibited only limited horizontal transport in the clay. The consultants are fairly confident that the creosote is localized and has not spread because the gray clay reduces flow to aquifer.

The area of contamination was estimated at 5000 square metres with volume at 40 000 cubic metres by Cherry and Smith (Cherry and Smith, 1987). This total volume of the soil was re-estimated to 8400 cubic metres by Poetker MacLaren Lavalin in 1990 (MacPlan, 1992).

The latest data available, as presented by UMA Engineering in 1996, has significantly increased the estimated volumes of contaminated soil. This is based on a the 1150 soil samples taken in 1995. The most recent estimates that the total volume of impacted soil above the commercial/industrial guidelines established by the CCME is 100 000 cubic metres. The total volume of impacted soil above residential/parkland criteria increases to approximately 160 000 cubic metres. Of the 100 000 cubic metres of soil exceeding industrial/commercial guidelines, approximately 10 000 cubic metres are estimated to have PCP concentrations exceeding 100 parts per million (ppm). Soils with PCP concentrations exceeding 100 ppm are considered by Manitoba Environment to be highly impacted.

Ground Water

Ground water has been tested with wells on and off site, both up and down stream. As of 1992, insignificant ground water contamination has been found. The most creosote related compounds have been located in a well just south of the fenced area. Increasing detection limits have resulted in an increase of compounds being detected. No remediation of the ground water was deemed necessary by the environmental consultants in 1992 (MacPlan, 1992).

The consultant reports stated that some low level contaminated water is getting off site, but because the flow in the bedrock is horizontal and rapid in directions governed by water supply wells in the vicinity of the site, complexities in the flow pattern in the aquifer induced by off-property pumping wells cause the fate of these chemical constituents to be unknown. The consultants could also not assess the contribution of the Domtar site contamination to the off-site contaminant levels measured in the ground water because the levels of contaminants tested for were negligible to non detectable in both the down and up stream test wells.

The UMA report presents the hypothesis that the most likely explanation for the presence of the wood treating chemicals in the aquifer is the historic use of the on site storm water drainage wells. This report states that ground water monitoring has demonstrated some migration of wood treatment chemicals down gradient of the former drainage wells. They go on to state that no analytical result exceeds the drinking water guidelines at the property boundary. Sample results to date, from the wells down gradient of the former operational area, have not detected PAH compounds or PCP.

Surface Water

Within area A, the area now fenced, the surface water is isolated and collection and treatment is in progress (MacPlan, 1992). The consultants believed that because the site is underlain with relatively impermeable clay the movement of the contaminants into the soil will be limited.

Appendix D: Chronology of Remediation Activities

The information presented here is meant to be only a cursory summary of the remediation activities that have occurred on the Transcona Domtar site. These activities have been outlined as part of both the MacPlan Environmental Consultant's report (MacPlan, 1992) and UMA Environmental's report UMA, 1996). A summary of remediation related activities also appeared in the *Winnipeg Free Press* in an article written by George Nikides (Nikides, 1991).

1976

Soil sampling began. Marvin Orloff was hired to demolish the wood treatment plant.

1977

The first remediation plan was accepted for the Domtar site in 1977. The first rehabilitation plan was prepared by MacLaren Limited as a consultant to Domtar. The proposal was centred around a cap and seal approach using clean clay. Zoning restrictions with caveats would be used to ensure that the capped contaminants would not be disturbed for the foreseeable future. Also as part of this proposal, was the removal of residual tank contents, buildings, and the closure of all wells on the site. No site development began because remediation was contingent on a development being accepted. A development plan was not processed because of a housing freeze under Plan Winnipeg.

1981

Concerns over the adequacy of the remediation plan resulted in the Ministry of the Environment requesting additional site characterization. This occurred between 1981 and 1984 and consisted of various sampling and analyses programs covering the entire site. In June of 1981 Professor Barry Webster of the University of Manitoba submitted a study that had been undertaken on the site. It indicated that there was a potential for problems and that the site required more work. In September of 1991 a housing freeze was lifted on the adjacent site by Gary Filmon who was then the environment minister. This allowed Genstar Developments to build homes to within 30 metres of the worst contaminated areas.

1982

Final rehabilitation report submitted by Domtar in December.

1984 through to 1988

A revision of the remediation plan was submitted and accepted in 1984 after Clean Environment Commission hearings in May of 1984. Several site specific remediation activities formed part of the new plan. These were scheduled for completion in 1985, however due to inclement weather some of these activities extended into 1986. These activities included locating, capping and sealing of the remaining wells; additional soil and pond water analysis; the drainage and backfilling of ponds; the segregation of wood chips; the spreading of clean chips; and the completion of the new cap design. From 1986 and extending into 1988 most of the major work occurring on the site involved testing by Cherry, a professor from the University of Waterloo. This testing was initiated in order to achieve an understanding of the subsurface contamination and its movement with an emphasis on ground water contamination. The movement of the contaminants on the site was computer modelled in this phase of remediation.

1989

In the summer of 1989, on-site remediation activities increased. A security fence was erected along with a series of warning signs. Debris and leftover railway ties were collected from outside the fence area in what were termed general cleanup activities. Monitoring continued.

1990

In 1990, remediation activities continued on the area inside of the security fence with the removal of subsurface debris. Concrete debris composed mainly of building footings were steam cleaned, hand ground, individually inspected and disposed of in the municipal landfill. There were 500 hundred tonnes of this material taken to the landfill. Outside the fence hot-spots of contamination were being located and removed. Ninety tonnes of contaminated debris were shipped by Laidlaw to their secure site in Sarnia, as well as 346 drums of the hot-spot material. One hundred and fifty tonnes of used railway ties were shipped to Full Spectrum Recycling in New Jersey, for use in their co-generation facility. Also during this time frame, a soil tilling and disking program began in the north section outside the fence. Ground water monitoring continued. Complaints of air emissions were launched by residents.

1991

The following year, the tilling and disking continued, as did the ground water testing and monitoring which also included the installation of additional wells. More security signs were fabricated and erected. Again, complaints of air emissions were launched by residents. In May of 1991 Dr. Cherry's report addressing possible ground water contamination is received by the provincial government.

1992

In 1992, more signs were erected, as was a security light inside of the fence. The remainder of the visual debris outside of the fence was removed and transferred inside of the fence. The site appearance was improved by chipping and mowing of the soil. The plant road to Gunn Road was upgraded to allow truck and other machinery to enter the site. Tilling continued. Two surficial hot spots were located which initiated another *hot-spot* survey in the fall. No new areas were found.

1993

Thermal desorption was selected as a remediation technique for the area known as 'A' and the site was prepared for this technique. Berms around the fenced area, an asphalt pad, and a tent structure to house the machinery, were the primary elements of this phase.

1994

A thermal phase separation system owned by TriWaste Reduction Services Inc. was installed on the site. This system failed to meet the established treatment limits which resulted in the decision by Domtar to discontinue the use of this unit and to have it removed from the property. The main reason for the failure of this technology was the unique soil characteristics found on the site. TriWaste Reduction Services went bankrupt.

1995

The property was repurchased from the previous owners in 1995. Additional site characterization was initiated to ensure that the remedial plan would consider the entire property. This more substantial investigation included the re-evaluation of the local hydrogeology and the installation of five additional ground water monitoring wells. The assessing of on-site and off-site ground water quality, and finally the screening of 1150 soil samples which resulted in 230 detailed chemical analyses.

1996

A new remediation plan was prepared by UMA Engineering. This proposal was based secure containment and capping of the contaminated soil on the site (UMA, 1996). The proposal was presented to the public on June 26, 1996.

Appendix E: Computer Equipment

The following accounts for the computer equipment used to prepare this study. In addition to this written report, a verbal presentation was prepared that was supported with slides and rendered panels. The panels were printed onto white bond paper and rendered with pencil crayon.

Hardware

All parts of the presentation were prepared using a Macintosh PowerBook 165 with Syquest EZ135 and Joule 540 hard drives. Images were digitized with a Hewlett Packard colour scanner. All copies of the written document were printed on a Hewlett Packard Laserjet 4MP. The over 25 000 words of the body text were set using the Times face at 11 points, with 16.5 points leading, normal track and kerning.

Software

Microsoft Word 5.1 and Adobe PageMaker 6.0 were used to process words and layout the written document.

Adobe Photoshop 3.0 was used for preparing images for the slide show and the written document.

Claris Filemaker 3.0 was used for the creation of a database of reference material.

Microsoft Excel 3.0 was used for generating the community survey graphs.

Microsoft PowerPoint 4.0 was used to create a slide show to support the final verbal presentation. The slides were output to film and developed.

Minicad 4.0 was used to generate the analysis diagrams. It was also used to generate the drafted drawings used as a base for the hand rendered presentation panels.

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Glossary

Primary references for the glossary are *Landscape Ecology* by Forman and Godron, *Landscape of Industry* by Cliff Tandy, and *Industrial Ecology* by T. E. Graedel.

Aquifer

A relatively permeable or fissured deposit which yields useful supplies of water when tapped by a well (Tandy, 1975).

Biophilia

An affinity for nature (Kellert, 1993).

Contaminated

A chemical or material out of place or present at higher than normal concentrations that is not necessarily harmful to any organism (Tandy, 1975).

Corridor

A narrow strip of land that differs from the matrix on either side (Forman and Godron, 1986).

Disturbance

An event that causes a significant change from the normal pattern in an ecological system (Forman and Godron, 1986).

Disturbance Patch

An area that has been disturbed within the matrix (Forman and Godron, 1986).

Ecology

The scientific study of the relationships between organisms and their environment (Forman and Godron, 1986).

Ecosystem

All of the organisms in a given place in interaction with their non-living environment (Forman and Godron, 1986).

Edge

An outer band of a patch that has an environment significantly different from the interior of the patch (Forman and Godron, 1986).

Edge Effect

A distinctive species composition or relative abundance in the outer band of the patch as different from the species composition or relative abundance of the patch interior (Forman and Godron, 1986).

Effluent

Any liquid which flows out of a containing space , but more specifically the sewage or trade waste, partially or completely treated, which flows out of a treatment plant (Tandy, 1975).

Exposure

The contact between a hazard and the target of concern, which may be an organ, an individual, a population, a biological community, or some other system. The confluence of exposure and hazard gives rise to risk (Graedel, 1995).

Ground Water

A continuous body of water in soil where spaces between soil particles are saturated (Tandy, 1975).

Hazard

A material of condition that may cause damage, injury or other harm, frequently established through standardized assays performed on biological systems or organisms. The confluence of exposure and hazard gives rise to risk (Graedel, 1995).

Health

More than the absence of disease, health is a state of complete physical, mental and social wellbeing (World Health Organization).

Holism

The theory that a material object, especially a living organism, has a reality other and greater than the sum of its constituent parts (Avis, 1989).

Hydraulic Conductivity

The rate of flow, usually in litres per day, through a unit cross section of soil under a hydraulic gradient of unity and at a specified temperature (Tandy, 1975).

Impervious

Term applied to strata or soils that will not permit the passage of water, petroleum or natural gas or only do so with difficulty (Tandy, 1975).

Industrial Ecology

An approach to the design of industrial products and processes that evaluates such activities through the dual perspectives of product competitiveness and environmental interactions (Graedel, 1995).

Landscape Architecture

The profession which applies knowledge of the earth's natural systems and human cultures to the planning, design and management of sustainable urban and rural developments. Its goals are to promote attitudes of respect, care and responsibility in conserving the landscapes of our heritage and understanding the physical and cultural environment in which new places are created. (Manitoba Association of Landscape Architects, 1994).

Landscape Ecology

A study of the structure, function, and change in a heterogeneous land area composed of interacting ecosystems (Forman and Godron, 1986).

Matrix

The most extensive and most connected landscape element type present, which plays the dominant role in landscape functioning. Also, a landscape element surrounding a patch (Forman and Godron, 1986).

Patch

A nonlinear surface area differing in appearance from its surroundings (Forman and Godron, 1986).

Permeability

The capacity of rock or soil to transmit water (Tandy, 1975).

Pollution

A chemical or material out of place or present at higher than normal concentrations that has harmful effects on any organism (Graedel, 1995).

Porosity (of a landscape matrix)

The measure of the density of patches in a landscape (Forman and Godron, 1986).

Porosity (of soil)

The degree to which a rock or soil contains interstices or voids (usually expressed as a percentage which indicates its water-holding capacity) (Tandy, 1975).

Reclamation

The act of returning a disturbed landscape to a functional use (Tandy, 1975).

Regenerated Patch

An area that becomes free of disturbance within a chronically disturbed matrix (Forman and Godron, 1986).

Remnant Patch

An area remaining from a former large landscape element and now surrounded by a disturbed area (Forman and Godron, 1986).

Remediation

The act of contaminate removal (Graedel, 1995).

Restoration

The act of returning a disturbed landscape to what is was prior to some impact on it (Forman and Godron, 1986).

Risk

The confluence of exposure and hazard; a statistical concept reflecting the probability that an undesirable outcome will result from specified conditions (such as exposure to a certain substance for a certain time at a certain concentration (Graedel, 1995).

Risk Assessment

An evaluation of potential consequences to humans, wildlife, or the environment caused by a process, product, or activity, and including both the likelihood and the effects of an event (Graedel, 1995).

Typology

The study of types, or a preclassification (Avis, 1989).

Thermal Desorption

Thermal desorption consists of contaminant extraction by heat induced volatilization from a contaminated medium at a suitable temperature which avoids premature breakdown of the compound (Graedel, 1995).

Water Table

The upper surface of the ground water below which soil and rocks are saturated; consequently the level to which the ground water reaches on each part of the site (Tandy, 1975).

Wood Treatment

The pressure of thermal impregnation of chemicals into wood to a depth that will provide effective long term resistance to attack by fungi, insects, and marine borers (Richardson, 1978).