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Editor's Note

Sarah Hansen and Jeremy Elder

Welcome to the sixth annual edition of *Trail Six: Undergraduate Journal of Geography*!

Every year Trail Six breaks new ground, and this year is no exception. From the unprecedented number of submissions we received, over sixty in total, to publishing in both digital and print forms, to the task of filling the exceedingly large shoes left by the previous Editors-in-Chief, Caitlin Sinclair and Knut Tjensvoll Kitching; this edition is truly an achievement. Of course, none of this would have been possible without the support of our dedicated editorial team, who graciously rose to the challenge of evaluating an enormous number of submissions, and worked tirelessly under increasingly tight deadlines in order to produce this journal. We would also be remiss not to mention the invaluable assistance given by the professors and staff of the Geography department, whose continued support, year after year, make this journal possible. In addition, we would like to acknowledge the executive and members of the Geography Students' Association, who, in addition to their incredible support of Trail Six, help to foster the sense of energy and community that makes this sort of project possible.

Most of all, however, we would like to thank you, the authors and the readers, whose ingenuity, curiosity, and academic drive make this journal what it is. Sixty papers is an exceptional number of submissions, and the quality of work we encountered made slimming the count down to just ten incredibly difficult. The calibre of the students in this department is off the chart, and this is in no small part due to the calibre of the department itself, and the unique and inspiring culture in place at UBC Geography.

We have an incredible assortment of papers to share with you. We hope you enjoy them as much as we did.

Sarah Hansen and Jeremy Elder
Editors-in-Chief
Trail Six, April 2012

Foreword

David Ley

I am honoured to introduce Volume 6 of Trail Six, which is in many ways the culminating achievement of this year's Geography Student Association. One of the significant benefits from my period as Head of Geography has been to get to know three cohorts of GSA execs and appreciate the huge range of social and professional development activities they put on through a mix of creativity meshed with hard work. Among these, Trail Six has in recent years become a significant accomplishment, as a labour of love produced by the Editors and their team for the benefit of the GSA membership and the wider community.

The production process is a learning process in terms of crafting new skills, and dealing with the pleasures and frustrations of teamwork. An apprenticeship served in meeting term paper deadlines is put to good use in product delivery to a larger market with the just-in-time, still warm from the printer, distribution of Trail Six at the graduating class' GeoGala at the beginning of April. To authors, editors, grant writers, producers and distributors: congratulations, this is a tremendous achievement.

This year Trail Six has expanded to ten papers and has returned to a print run in addition to its internet posting. The papers that appear have been reviewed by faculty mentors, and reflect contributions from each major undergraduate stream in the Department. The issue begins with three examples from the BA stream in Human Geography. The Woodward's Redevelopment in Vancouver continues to be a major talking point in the city, and Andy Longhurst offers a well-illustrated photo essay that discusses the Woodward's Building as an expression of class power, with older working-class landscapes and memories erased by a middle-class incursion into the Downtown Eastside. Published close to the death of Jim Green, Downtown Eastside organiser and a key shaper of the social housing component of the project, this essay will continue the discussion about appropriate models of development in the city's poorest neighbourhood. Brittany Morris explores inequalities in a very different context in her paper on service provision in South Africa. Brittany argues that the privatisation of water supply in the context of a freewheeling market economy is bringing unacknowledged continuity to the older inequities associated with apartheid. Returning to Vancouver, George Rahi, Andrew Martynkiw, and Emily Hein provide an empirical assessment of privately owned public spaces, one of many landscape features associated with public-private partnerships in the city. Using both archival and observational methods, the paper assesses the success of these spaces for public use and interaction.

Reflecting the tremendous growth of student interest in the Environment and Sustainability program, several papers address issues of sustainability and nature. Knut Kitching reviews agricultural reform in Sub-Saharan Africa. The green revolution has experienced mixed results in this region, and the paper assesses the appropriateness of introducing reform models from elsewhere

into the cultural context of indigenous agriculture during a period of environmental change. Jeremy Elder offers a related paper deconstructing the terminology of environmental degradation. These narratives commonly impute blame to subsistence communities for 'degrading' land practices by drawing upon a universal field of knowledge. Sometimes, however, these narratives, by failing to consider the insights of local knowledge, tend to re-impose a colonial epistemological grid that can justify the imposition of western-style land and ownership patterns. Turning to a local example of urban nature, Kevin Chan examines the fate of Still Creek, one of a very few original creeks in Vancouver that have not been entirely contained in sub-surface flows. But Still Creek, though partially a surface stream, is far from natural, with extensive changes to its channel through dredging and other processes to make it a 'water-disposal machine'. In a complementary account, Caitlin Sinclair addresses the broader issue of 'stream daylighting', the managed return of urban streams to surface flow. The paper offers a wide-ranging assessment of this model of urban restoration and the conservation ideology that underpins it.

A final section of this year's Trail Six includes three papers reflecting the Biogeosciences and GIS program. Jordan Booth and Lauren Punt offer a fascinating review of the potential breaching of its morainic barrier by glacial lake Imja Tsho in Nepal. Part of the interest of this paper is its use of both quantitative and qualitative methods, with its conclusion that while a quantitative model forecasts relative security, a qualitative assessment identifies considerably more danger for downstream communities. Victor Ngo introduces the reader to the policy of transit-oriented development (TOD). Applied to Vancouver, TOD would concentrate population and development intensification around new transit stations on the rapid transit system. Using a GIS inputting various intensification criteria, the analysis identifies ten stations on the existing transit system with potential for much higher densities. Finally, Lauren Weatherdon and Jonathan Walker provide an environmental assessment of three master-planned communities in Howe Sound in terms of slope gradients and the minimising of impacts to terrain of rich biodiversity. This multidimensional assessment also acknowledges economic feasibility in project development and comes up with a ranking of the three communities.

Congratulations to each of the authors in making it through the review and editorial stages, and welcome to the pleasure of seeing your own research in print and distributed to a larger readership. For many of you, this will be your first, but far from your last publication. Well done on this impressive debut, and be sure to add this entry to your resume. We look forward to seeing your names in print again!

David Ley
Head of Department

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Neoliberalism, Privatization and Class Power

AESTHETICIZATION AND CONSUMPTION IN ADVANCED CAPITALISM: THE WOODWARD'S REDEVELOPMENT AS A LANDSCAPE OF CLASS POWER

Andrew Longhurst

***Abstract**: Canada's poorest neighbourhood, Vancouver's Downtown Eastside, is undergoing significant social and economic change. Many believe that the Woodward's redevelopment project is the key to revitalizing the neighbourhood by encouraging capital (re)investment. I argue through a photo essay that the Woodward's redevelopment must be understood as a landscape of class power. The state and private capital are simultaneously attempting to gentrify the neighbourhood through the embourgeoisement of the built environment. The aestheticized landscape of advanced capitalism, characterized by spaces of conspicuous consumption, is articulated both materially and symbolically. The Woodward's landscape privileges the new urban middle class, by materially and discursively erasing working class histories and struggles in this neighbourhood. This redevelopment is perhaps Vancouver's most striking example of flexible accumulation at work – a process which is occurring globally in cities through landscape aestheticization and the middle class colonization of poor and working class neighbourhoods.*

Introduction

The urban geography of the Downtown Eastside (DTES) is complex and poorly understood, and is the historic centre for much of the early Euro-Canadian settlement of Vancouver. The historical geography of the area is especially fascinating, as it was the port for BC's prominent resource sectors of the nineteenth and twentieth centuries. Fast-forward to the latter half of the twentieth century and the DTES had become Vancouver's 'skid row', and was consequently characterized by commentators in an entirely different light.

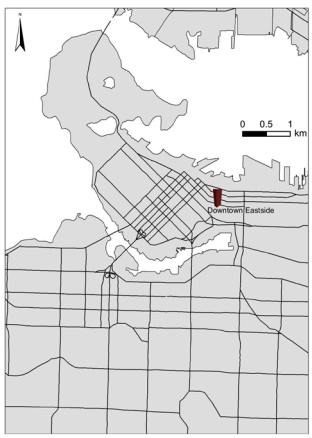

Figure 1. Location of Woodward's in the Downtown Eastside. Map by the author.

The neighbourhood experienced significant social and economic change from disinvestment as downtown businesses moved west, suburban development drew investment out of the inner city, resource sector unemployment increased, and psychiatric de-institutionalization by the provincial government put mentally ill patients on the street (Blomley 34-35). But this process of inner city disinvestment and then reinvestment is certainly not unique to Vancouver.

Gentrification is most pronounced in post-industrial cities and a number of theories exist to explain this phenomenon (Ley and Dobson 2472). In one theory, a "rent gap" exists in inner city locations, in which there is a sizeable difference between the existing rent collected from the current land use versus the potential rent which could be collected under the so-called highest and best use of the land. In Vancouver, inner city property has experienced greater increases in value and investment compared to suburban property (Skaburskis and Moos 905), fuelling property speculation and redevelopment in the inner city. Another account considers the cultural and aesthetic sensibilities of the new middle class, and their desire for urban living and the amenities of an inner city location. Finally, an additional explanation argues that gentrification must be understood as a move to the revanchist city, as the middle and upper classes take back the city from the poor, who live on increasingly valuable inner city land with significant rent gaps. Many gentrification scholars, including Neil Smith, argue that this revanchism often occurs through anti-poverty policing and housing policy (elimination of non-market housing) to displace the poor and working class.

Figure 2. Photograph by the author (2011)

This thesis can be extended to argue that gentrification is now a global urban neoliberal strategy to re-establish middle and upper class power in cities (Smith 431). Throughout this paper, I use the terms neoliberal(ism) and advanced capitalism to describe the current, conservative economic orthodoxy – the fetishization of, and adherence to, capitalist market logic in the ordering of economic and social life. I borrow from Slavoj Žižek in using cultural capitalism synonymously, but I emphasize the cultural and aesthetic values that are part of this current period of capitalism.

There is an underlying economic incentive to redevelop the DTES and to foster further redevelopment by creating the conditions necessary to encourage developers to invest in a financially riskier neighbourhood. A cultural explanation of the aesthetic sensibilities of the new middle class must also be part of our understanding of the embourgeoisement of the DTES, a term I borrow from David Ley to refer to the social transition in the inner city, where class and status connotations are most significant, without making reference to specific changes in the housing stock (Ley 8). With these theoretical foundations in mind, I now turn to the specific historical context of the Woodward's redevelopment.

The Woodward's department store that occupies nearly an entire city block was considered the economic heart of the neighbourhood throughout the twentieth century, providing working class residents with an affordable and practical shopping experience (Blomley 39). But in 1993, Woodward's closed its doors, and questions arose about the future of the site. After nearly ten years of debate, community mobilization, and political manoeuvring by provincial and municipal politicians (Blomley 39-46), the site was redeveloped in 2006 into a mixed-use project, often touted for its commitment to affordable housing and neighbourhood 'revitalization' (City of Vancouver, "DTES Revitilization"). The Woodward's redevelopment is a landscape, and the built form suggests a particular visuality, a 'way of seeing' this urban geography. Visuality is a socially constructed way of seeing, which is different from vision,

a biophysical function (Rose 801-802); and the visuality of the Woodward's site (Figure 2) and the surrounding area is the most striking feature of the 'remaking' of this urban geography.1 For both community activists, including the Carnegie Community Action Project, and urban scholars, gentrification is very much a reality in this neighbourhood (Lees, Slater and Wyly 269), especially with the number of market housing units increasing and affordable housing stock declining (Culbert). We are literally seeing the embourgeoisement of this neighbourhood as the built form is gentrified by developers and the state for the middle class (Ley 34). I will primarily draw from the gentrification literature and theoretical concepts in cultural geography to situate Woodward's within larger processes of urban social and economic change. Borrowing Sharon Zukin's terminology of particular landscapes, the Woodward's redevelopment, as a public-private partnership, is a "landscape of power." The built form both materially and symbolically enforces class divisions and assists with gentrification as a class project. The embourgeoisement of the built form – through building improvements, the incorporation of art

Figure 3. An earlier horizontal civic ideal? Looking west down Cordova Street from Cambie. Photograph by the author (2011).

into the design, and general beautification – appeals to middle class aesthetic sensibilities, enforcing landscapes of class power and privilege. These landscapes are meant to establish a postmodern or neoliberal middle-class geography of consumption through the extraordinary aestheticization of the built environment.

The DTES has resisted gentrification for the past 30 years, even when many Vancouver neighbourhoods were undergoing significant change. Ley and Dobson argue that the significant amount of social housing still existing in the area, the high concentration of poverty, and the raw street culture have posed barriers to gentrification in the Downtown Eastside (Ley and Dobson 2474-2484). The Woodward's redevelopment cannot remove all of these barriers, but it is laying the groundwork to foster gentrification, although problematically ignoring the underlying causes of the neighbourhood's poverty: " [the] aestheticization of the middle-class landscape […] plays an important role in masking class inequality and urban segregation" (Pow 374). To see these spaces of embourgeoisement in this emerging landscape, I will explore aspects of the material and symbolic

Figure 4. Photograph by the author (2011).

Woodward's landscape, as well as the surrounding area.

Situating Woodward's: A Neoliberal Landscape Of Spectacle, Consumption, And Flexible Accumulation

Before looking at Woodward's as a landscape of middle class power or a site of gentrification, I will situate Woodward's within the neoliberal urban experience. Don Mitchell reminds us that landscapes are a work and they do work (Mitchell 4-8). Landscapes are a work because they have materiality – they have physical structure and are created through labour. And landscapes do work symbolically by making normative claims to what space should look like and thus legitimize the embedded social relations. Landscapes can symbolically reinforce the ideas of the ruling class, as part of an ideological framework, in the case of Woodward's, to make middle class claims to urban space. As geographers, we must be careful not to valorize landscapes for their cultural or postmodern aesthetics, which do work by masking capitalist social relations.

Figure 5. Photograph by the author (2011).

Woodward's is a landscape of the neoliberal revanchist city, and an example of the "cultural clothing" of urban flexible accumulation (Mills 155). Flexible accumulation, a regime of capitalist accumulation notable for its diversity and differentiation, thrives through urbanization, and more specifically urban redevelopment projects which today are often flexible in their method for securing capital accumulation (Faulconbridge 256-257). As a state-led redevelopment project, Woodward's is a striking example of an urban gentrification strategy within the post-Fordist regime of flexible accumulation. It not only includes market condominiums, but commercial and retail space, as well as non-market housing (albeit a much smaller percentage) to secure the support required from centre-left politicians and voters. The Woodward's redevelopment may be the most striking application of Harvey's flexible accumulation in Vancouver's urban geography.

Guy Debord's critical commentary of mass culture provides another important theoretical framework to understanding these connections between current cultural capitalism and the Woodward's landscape as a spectacle and manifestation of class power. The visuality of consumption in the Woodward's area has profound implications for social relations in the DTES: "The spectacle is not a collection of images, but a social relation among people, mediated by images" (4). The redevelopment is a spectacle because of the scale of this project in contrast to the endemic poverty in the neighbourhood, the attention to the cultural aesthetics of advanced capitalism, and the considerable hoopla surrounding the project within popular discourses. Woodward's is a landscape of spectacle, seen as a collection of images rather than a social relation among people.

Spectacles and landscapes, as Debord and Mitchell argue, must therefore be revealed for attempting to conceal capitalist social processes. These images of Woodward's, which I will explore through photography, are inherently capitalist social relations. The making of the spectacle, or the spectacularization, and the embourgeoisement (Ley 34) of Woodward's storefronts and the architecture itself; facilitates a spatial exclusion between those who 'belong' and those who are excluded because of their inability to consume.

Figure 6. The original W in the foreground and the new W in the background. Photograph by the author (2011).

The Landscape And Spectacle Of The Woodward's Redevelopment

Woodward's has brought undeniable change to the neighbourhood. The redevelopment includes 200 non-market housing units (Fink, email message to author),2 a daycare facility, the SFU School of Contemporary Arts, London Drugs, TD Canada Trust, JJ Bean, Nester's Market, non-profit, municipal, and federal office space, the Charles Bar, and other small businesses (City of Vancouver, "The Future of Woodward's"). Most significant and visually striking are the 536 market condos spread across two towers (Figure 2; Terra Housing Consultants), which start at $415,900 for one and two bedroom suites (Westbank and Petersen Group). With 43 and 32-storey towers dominating the neighbourhood, Woodward's is a landscape of spectacle and class power:

> [The] built form of downtown – sleek, dense, tall – embodies the growing outreach of capital investment and the enormous concentration of authority where investment decisions are made. […] Their verticality replaces an earlier, horizontal civic ideal, forcing a change of both the landscape and perspective (see Figure 4 in contrast to Figure 3; Zukin 186).

But what does it actually mean to characterize Woodward's as a landscape of power?

As a landscape, the Woodward's redevelopment is inherently ideological and "it represents a way in which certain classes of people have signified

Figure 7. Stan Douglas's Abbott and Cordova. Photography by the author (2011).

themselves" (Cosgrove 15). Landscapes are both material and symbolic (Blomley 53; Mitchell 4-8) – the material space of Woodward's is the built form and the ideas that the redevelopment suggests. This landscape of class power materially plays into hegemonic notions of who belongs in the inner city. If you have the income, then you can live in a Woodward's tower. Symbolically, this landscape suggests what the Downtown Eastside ought to look like through the aestheticized redevelopment of inner city space for the new middle class. Examining the role of heritage aestheticization in this landscape, it becomes apparent how the "features of the landscape are a means for fixing social position," and how "gentrification is a cultural tactic by which a new geographical space authenticates a new 'place' in the interstices of social structure" (Mills 157).

Figure 8. Photograph by the author (2011).

The embourgeoisement and gentrification of neighbourhoods is achieved discursively and materially. Claims to urban space are made through a language of historic preservation and best-use. Historic buildings 'belong' to those with the financial capital to properly explain, analyze, and understand historic buildings "as part of an aesthetic discourse" (Zukin 193). Woodward's developers and marketers have symbolically reproduced Woodward's as a place of "heritage" and "respect" (Westbank and Petersen Group).

The advertising language symbolically constructs this as a redevelopment that now "champions ideals of heritage revival" (ibid), but also has the capacity to "reinvent" (ibid) the neighbourhood as a neoliberal or postmodern landscape of middle-class consumption. David Ley unpacks the irony of this new landscape:

> The argument for historic preservation conceals the fact that with gentrification almost nothing is preserved. The original households are replaced, and the meaning of the structure is redefined from a working-class use value to an aestheticized symbolic value. […] [The] built-form becomes scarcely recognizable from its former appearance. Yet what is celebrated is the authenticity of the renovation, its fidelity to what has gone before. Here a rather different magic is at work, as the transformation of buildings is declared to be an act of fealty to the past. (Ley 310)

This "aestheticized symbolic value" is most vividly displayed by the preservation of the original 1903 building facade at West Hastings and Abbott (City of Vancouver, "The Story of Woodward's"), the preservation and placement of the original 'W' sign in the courtyard, and the installation of Stan Douglas's Abbott and Cordova photograph in the central atrium.

The preserved 1903 building facade (Figure 5) is the only remaining part of the physical structure of the Woodward's department store. Like other historic facades, it serves as a symbolic representation with an ideological purpose of 'honouring' the past, while presenting an aestheticized, 'pre-

served' look for middle class consumption. These elements of "[…] historic character and distinctive period architecture [are] important building features in alluring the new middle class into inner-city locations" (Ley 310). With this intentional nod to heritage, consumption remains central to this highly symbolic neoliberal landscape. TD Canada Trust is located in the ground-level corner of this building with the 1903 facade (Figure 5). Who is this bank for and how does it entrench the Woodward's redevelopment as a landscape of class power and consumption? With no explicit social mission to empower this historically marginalized low-income community, it is evidently there to serve middle-class residents and local businesses. The bank is part of the embourgeoisement of the DTES and provides gentrifiers with convenient access to their financial capital, which they use to further gentrify the neighbourhood.

In similar respects, the juxtaposition of the original and new 'W' signs (Figure 6) and the installation of Douglas's Abbott and Cordova are also evidence of Ley's "aestheticized symbolic value," and can be understood as 'monuments' commemorating the "government's ascendancy" and "the permanence or atemporality of its rule …" (Wells 139). The 'W' sign on display in the courtyard is an example of a spatial practice outlined by David Harvey – the appropriation of space. The Woodward's department store catered to low and modest-income residents, yet the site is now primarily oriented towards middle-class consumption, with the sale of luxury condos, cocktails at The Charles Bar, and lattes at JJ Bean. This juxtaposition can be read like a text (Cosgrove and Jackson 96-97). The state, developers, and middle class gentrifiers justify the remaking of this space into a new middle class landscape because they are acknowledging and 'respecting' the neighbourhood's past through symbolic gestures of historic preservation.

Figure 9. Photograph by the author (2011).

In 1971, Vancouver Police violently responded to a smoke-in, at Gastown's Maple Tree Square, of residents, hippies, and activists protesting policing practices, and the state more generally (Kamping-Carder, par. 1-6). Stan Douglas's Abbott and Cordova is a reproduction of the scene – and a large installation of the work has been placed inside the Woodward's atrium (Figure 7). This spectacularized monument – a spectacle itself that must be viewed in person to be fully appreciated – is used to appropriate space, through an aestheticization of activism and neighbourhood 'grittiness', only to remake this into a landscape of conspicuous consumption.

David Harvey finds city planners, and the state, more generally, complicit in class appropriation, evident through the example of the 'W' signs as well as the Abbott and Cordova installation:

> Planners can try to ensure that the transformations of neighbourhood will preserve rather than destroy collective memory. Far better that a deserted factory be turned into a community centre where the collective memory of whose who lived and worked there is preserved rather than being turned into boutiques and condos that permit the appropriation of one people's history by another. (Harvey 281)

The City of Vancouver has not only been complicit in sponsoring this appropriation of space,

but has taken part in it. The municipal and federal governments occupy office space in the redevelopment, helping to legitimize spatial exclusion and class appropriation. Woodward's exemplifies redevelopment "[straddling] public and private

Figure 10. Photograph by the author (2011).

power" (Zukin 195) with the City of Vancouver's Social Planning Department and the National Film Board of Canada opening offices there.

The Spectacle Spreads: Aestheticization And The Embourgeoisement Of The 'Woodward's District'

The aestheticized landscape of Woodward's is not limited to the redevelopment itself, as the surrounding blocks are beginning to look markedly different. While Stan Douglas's Every Building on 100 West Hastings is meant to highlight the emptiness, disinvestment, and the dilapidated buildings of the block, it also captures the built landscape before the block's embourgeoisement.3 When the photograph was taken in 2001, many of the storefronts and historic buildings were boarded up, unoccupied, and unrestored. My photography of the 100 West Hastings block reveals a very different landscape – aestheticized, gentrified, and occupied by businesses with lofts above. Many of these businesses cater to the 'aestheticized self' and to an aestheticized urban living space of the new urban middle class.

There is a personal training centre and Brazilian jiu-jitsu studio across from Woodward's (Figure 8), "reinforcing the leisure preferences of gentrifiers for fitness and outdoor activities, these centres are concentrated in districts settled by the new middle class" (Ley 337). The "BeFresh Salon and Spa" has also recently opened its doors (Figure 9). High-end furniture and home-living stores are located on West Hastings and Cambie Streets, in proximity to Woodward's (Figure 11). Moreover, aestheticized cafes have opened to cater to a new middle-class clientele demanding a cosmopolitan eating experience (Ley 308-309). The "Meat and Bread" sandwich restaurant (Figure 10), in the same block as Woodward's, has even wooed Alexandra Gill, a Globe and Mail food critic, by helping the neighbourhood "[go] gourmet" (Gill).4 These businesses, concentrated in the blocks surrounding the site, reflect the aesthetic sensibilities and consumption practices of the new middle class. A number of buildings have been 'restored', leased to upscale businesses or have yet to be leased (Figure 9). It will be interesting to see how this landscape of power and embourgeoisement

Figure 11. Photograph by the author (2011).

continues to evolve, as gentrification is a process not an end state.

It is not simply these new businesses that represent a remaking of this landscape; the new con-

dos and lofts above these businesses provide the aestheticized housing for the gentrifiers who will frequent these stores (as well as the Woodward's redevelopment itself). The "Paris Block" lofts have recently been 'restored' and lofts in the new "Paris Annex" development are on sale (Figure 12; The Salient Group, "The Paris Block"). The Woodward's redevelopment signals a major shift in this neighbourhood's landscape, symbolically and materially – and Harvey's extensive research on the remaking of central Paris in the nineteenth century provides an interesting comparison:

> It was for this reason that the reoccupation of central Paris by the popular classes took on such symbolic importance. For it occurred in a context where the poor and the working class were being chased, in imagination as well as in fact, from the strategic spaces and even off the boulevards now viewed as bourgeois interiors. The more space was opened up physically, the more it had to be partitioned and closed off through social practice. (Harvey, The Limits to Capital 204)

The interiors of this neighbourhood are being symbolically and materially transformed into gentrified, middle class spaces through a powerful appropriation and domination of space. This partitioning of space is spectacularized, but there is a particular social relation mediated by these images of aestheticization (Debord 4). The Woodward's landscape, made up of the many images seen by DTES residents (luxury condos, an upscale coffee shop, an expensive bar), strengthens social exclusion, by demarcating middle and upper class space. The spectacle of poverty and addiction in "the worst block in Canada" (Sommers and Blomley 19) juxtaposed with this hyper-aestheticized landscape of consumption highlights the extreme socio-spatial polarization underway (Paperny and Dillon).

Figure 12. Photograph by the author (2011).

Conclusion

The visuality of landscapes allows us to read spaces symbolically and materially. Landscapes are highly ideological and inform us of how power is deployed. A critical reading of the 'Woodward's district' landscape allows us to understand the complex socio-economic processes at work. Therefore, a critically informed photo essay of this evolving landscape seems appropriate in order to explain the embourgeoisement and intensifying gentrification, which attracts such scholarly and popular attention because of its visible form (Mills 150).

It was not until the fall of 2010 while walking through the Downtown Eastside that the visual landscape had a profound emotional effect on me. I was struck by the sharp contrast between the rapid embourgeoisement of the Woodward's area and the incredible displays of poverty and dilapidated single-room occupancy hotels. In a sense, this was the inspiration for

this project. Later in January 2011, at the UBC School of Community and Regional Planning's Annual Symposium, I responded to a developer after he characterized the changes as bringing 'normality' to a neighbourhood that, by his logic, was 'abnormal.' This was a very real display of discursive power at work. These experiences have shaped the way I read this particular inner city landscape. While developers and the state often attempt to make the Downtown Eastside community invisible in one sense (through the Woodward's redevelopment or the recently attempted density increase), the 'revitalization' of this neighbourhood is spectacularized and made highly visible by the Woodward's redevelopment and the embourgeoisement of adjacent buildings. These many processes at play ultimately create a middle class space through class appropriation and domination, and through the symbolic and material work of these landscapes.

As critical geographers, it is our task to understand and challenge the neoliberal urban condition that elevates consumption and exacerbates socio-spatial injustice in our cities. But this is about more than gentrification, as Caroline Mills reminds us: "The project of gentrification is a discourse about landscape which offers, in turn, a discourse about society" (Mills 168). How much redevelopment and 'heritage preservation' should we permit in the central city? The Woodward's redevelopment has led to "the seemingly innocent pleasure in the aesthetic appreciation of landscapes and the desire to protect [their] beauty and serenity of landscapes … [acting] as a subtle yet highly effective mechanism for social exclusion and the reaffirmation of elite class identities" (Pow 373). Perhaps we should begin by questioning the increasing "aestheticization of urbanity" (Ley 299) the pervasive regime of flexible accumulation in these neoliberal times, and the accompanying hegemonic spatial practices at work in our cities.

Acknowledgements

I would like to thank Jeremy Elder and David Ley for graciously editing this essay. Sam Mickelson, Linda Netherton, and Doug Longhurst provided valuable comments and encouragement. I also want to thank Mia Edbrooke for our wonderfully critical discussions on this topic, and for providing constant support. Any errors or omissions remain mine.

ENDNOTES

1. I took these photos of the Woodward's redevelopment and the surrounding area on March 5, 2011.

2. Tanya Fink graciously responded to my enquiry about rental rates for the 'non-market' units. She is a graduate student at the UBC School of Community and Regional Planning and has studied the social aspects of the Woodward's redevelopment quite extensively. She verified that 125 non-market rental units are indeed managed by Portland Hotel Society at the welfare rate of $375 per month. It is difficult to find any public information about the rental rates for the remaining 25 'non-market' family units. A March 2011 post on Craigslist indicated that two-bedroom Woodward's units explicitly for "families with children" are renting for $1,385 to $1,420. This is less than market rental rates, but this is hardly affordable for low-income families, and this is most definitely not social housing. The terms 'affordable housing' and 'social housing' get thrown around very loosely in the popular discourse. There has been a commitment to actual social housing with 125 one-bedroom welfare rate units. I believe it is most useful to critically analyze the ratio of truly 'non-market' units to market units. Keep in mind that 536 market condos were included in this project. Even compared to the supposed 200 non-market rental units, the influx of middle-class residents into this neighbourhood is particularly important. The specific Craigslist posting for the non-market family units for rent was found here: Craigslist Vancouver. "$1385 / 2br - NEW WOODWARDS PROJECT (DOWNTOWN)," Craigslist, http://vancouver.en.craigslist.ca/van/apa/2219947567.html.

3. The photograph is easily found online. You can also see the photography in Stan Douglas's book Every Building on 100 West Hastings (see Works Cited).

4. he Salient Group is a 'heritage restoration' company marketing The Paris Block lofts. Interestingly, they never make reference to the 'Downtown Eastside,' choosing to use 'Gastown' or 'Woodward's District' to describe the location of these new lofts.

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WATER APARTHEID? A CASE STUDY EXAMINING THE PARALLELS BETWEEN WATER PRIVATIZATION IN NEOLIBERAL SOUTH AFRICA AND INEQUALITIES IN APARTHEID

Brittany Morris

***Abstract**: The end of apartheid in 1994 simultaneously transitioned South Africa out of a crime against humanity, and into the perilous grasp of neoliberalism. The neoliberalization of South Africa remakes the inequalities entrenched in apartheid. I sketch a foundational framework of South Africa's neoliberalization by examining the national and international actors present in the country's neoliberal transition. Under apartheid, access to basic infrastructure and services was dictated by race and spatial locations, establishing immense inequalities. In neoliberal South Africa, those precise inequalities are regenerated through water privatization to produce what Patrick Bond calls 'water apartheid'. I thus focus on how neoliberalism redevelops the inequalities of South Africa's apartheid period.*

Introduction

The release of Nelson Mandela on 11 February 1990 after twenty-seven years of imprisonment symbolized the first steps of dismantling the long-standing injustices of apartheid. Apartheid, the heading given to the racially determined segregationist policies enacted by the South African government, resulted in the torment of the various non-white populations of the country for almost half a century. Legacies of inequalities produced during this period live on today. Due to the neoliberalization of South Africa, the post-apartheid era resembles the precise inequalities Mandela's vision sought to expunge. Neoliberalization is a "process of political-economic change" (Tickell and Peck 166) where the state deploys market rule and principles (Tickell and Peck 163-181). The new government of South Africa adopted a market-led approach to development in their reform policies while in a time of state distress and fiscal constraint, in order to redress the poverty and structural inequalities inherited from prior racial segregation policies[1]. An equitable distribution of public services was needed and privatization, the transfer of the management and/or ownership of a service from the public to the private sector, was the internationally deemed rationale as an alter-

1.See South Africa, White Paper on Reconstruction and Development (1994), South Africa, White Paper on Water Supply and Sanitation Policy (1994), the Growth, Employment and Redistribution Strategy (GEAR 1996), South Africa, White Paper on a National Water Policy for South Africa (1997) (Cheru 508, Gualtieri 1).

native delivery service model for municipalities struggling with state retrenchment in delivery services while prioritizing fiscal austerity. Applying an economic approach to water management and governance in South Africa's post-apartheid water framework followed, as privatization became the 'pro-poor policy choice' (Cheru 506-525; Gualtieri 1; McDonald and Ruiters 30; Smith 377-384).

Through a critical analysis of the consequences produced by capital-centric South African water policies, I argue that neoliberalism regenerates inequalities apparent during apartheid. Though many facets within neoliberalism perpetuate inequality, I focus on the detrimental effects propagated by the inclusion of the market-oriented economic paradigm in South Africa's water policies. The neoliberalization of South Africa and the reforms of the country's water services are sketched as a foundational framework to illustrate the parallels between inequalities produced by water privatization in present-day South Africa and those produced during apartheid. Thus I contend that through water privatization, neoliberalism manifests apartheid's legacy of racial and spatial inequalities by producing factors that ultimately continue water-access disparities between neighbourhoods, households, and individual livelihoods in South Africa.

Context: The Path Towards Water Privatization In South Africa

The end of apartheid in 1994 simultaneously transitioned South Africa out of a crime against humanity, and into the perilous grasp of neoliberalism. Neoliberalism is the market-oriented, capital-centric economic 'order', preponderant within politics and financial institutions for the past thirty years. 'Neo' derives from the fact that this economic paradigm came into global focus post-Keynesianism, and 'liberal' because neoliberalism promotes both financial and trade liberalization (Tickell and Peck 166). The neoliberalization of South Africa was based on the neoliberal economic advice of the World Bank, influenced by the coherency of neoliberalism as a "powerful ideological package" (McDonald 77), and "promoted vigorously [by] financiers from New York, London, Zurich and Johannesburg" (Bond "Economic" 414). All asserted that a plethora of benefits on a local and national scale would follow (ibid; McDonald 77). Privatization, a facet of this dominant economic paradigm, largely contributed to the neoliberalization of South Africa.

Privatization has been deemed, among others, a notable mechanism for fiscal restraint "without abandoning government's commitment to service delivery to the poor" (McDonald 175). Additionally, privatization offers windows for investment and opportunities, facilitating economic growth in the process. The belief that privatization could serve as a gateway to instill the "services and infrastructure required for renewed capital accumulation" (ibid), such as airports, roads, and electricity systems across the South African landscape also prevailed among arguments for the transition (ibid). Reregulation – the reform of regulatory practices and modes of governance –facilitated the privatization of the service sector through a shift in institutional policies that allowed the commodification and corporatization of basic services (McDonald and Ruiters 19-29; Smith). Guided by neoliberal principles and various national and international influences, the South African government sought to redress inequalities of apartheid's legacy through a more "equitable (re) distribution of services" (McDonald 173) — the privatization of water aptly ensued.

Legislative developments propelled the promotion of water privatization. The first legally binding declaration from the African National Congress outlining water's entrance into the private sphere was the adoption of the Water Services Policy in 1994. Putting privatization into practice, the Wa-

ter Services Act (1997) and National Water Act (1998) quickly followed (McDonald and Ruiters 25). In following a neoliberal agenda, grants and subsidies of public services decreased. Privatization subsequently became the leading avenue for local municipalities' and legislations' capital accumulation to withstand the capacity of basic service provision (McDonald and Ruiters 24-28; Miraftab 876-877). Thus the legislative commencement of the Municipal Services Act in 2000 enabled local government structures to privatize public water utilities (McDonald and Ruiters 24-25). A foundational element in the incentive for the commodification of water is the potential for profit as the worldwide water sector generates an estimated US $1 trillion annual revenue. The underlying neoliberal tendencies of the reregulation of water services were enforced and supported by internal factors such as South African consultancy firms (PriceWaterhouseCoopers and KPMG especially), national and local chambers of commerce, and local and microenterprise businesses who would largely benefit financially and opportunistically from the transition (McDonald and Ruiters 30-32). Though there is South African promotion of privatization, many international actors extend their influence in South Africa's water policy decisions.

Water privatization is promoted by a plethora of agencies engaged with the South African policy decision process. International financial institutions, bilateral donor and world development agencies, local and national pro-privatization firms, neoliberal media biased towards privatization, and the vast majority of local and national authorities and politicians collectively enforce the commercialization of water as the best choice. The World Bank "is arguably the single most influential body in the world of promoting water privatization" (McDonald and Ruiters 32). The neoliberal financial institution has plunged its hands deep in South African policy reforms since the early 1990s; enforcing neoliberalism by "promoting privatization of water and other essential services" (McDonald and Ruiters 32) as a rational policy choice that "really works" (ibid). Development banks such as the European Investment Bank and the Development Bank of Southern Africa, as well as bilateral aid agencies – such as the United States Agency for International Development (USAID), the Canadian International Development Agency (CIDA) and Britain's Department for International Development (DFID), urge privatization as a means for generating foreign investment. Many bilateral development agencies incorporate water privatization in their aid conditionalities, or support privatization by either collaborating with multilateral agencies – as the United Nations Development Programme (UNDP) did with the World Bank – or pro-privatization coalitions such as the highly influential World Water Council (McDonald and Ruiters 30-32). Despite the incentives of South Africa's post-apartheid government to redistribute services on an equal basis, water delivery remains highly unequal.

Regenerating Inequalities Through Water Privatization

Grounded in a neoliberal-oriented framework, water distribution mechanisms produce highly unequal distribution of water services. Provision of adequate services is only available to those able to pay. This distribution system undermines the declared right to have access to sufficient water in South Africa's Constitution. As privatization coincides with the 'roll-out the state' form of neoliberalism (Tickell and Peck 172-178), whereby services are provided on the ability to pay, rather than on need, water distribution structures exacerbate disparities between neighbourhoods (Smith 383). The transformation of water into a privatized commodity increases wealth accumulation in a small number of hands on both a local and global scale, and low-income households became burdened with the disadvantages of water privatization. Implications of this are evident in the

everyday post-apartheid inequalities suspended in water privatization.

Though the Constitution reflects equality, the amount of water received is increasingly determined by the practice of cost recovery, whereby consumer tariffs are introduced to pay for the capital costs and marginal costs of water service (Flynn and Chirwa). Infrastructure disparities lingering from apartheid perpetuate present consequences of water privatization due to former racialized policies preventing the development of essential service infrastructure within townships, and strictly regulating black urbanization (McDonald; Smith 382). Predominantly black areas and townships of poor infrastructure pay more for service delivery as such areas have higher cost reflective prices, whereas wealthier suburbs, predominantly white, receive lower service delivery costs for the same services (Flynn and Chirwa; Miraftab 875-878). For example, "prepaid metres in rural KwaZulu-Natal charge multiple times the price per litre of water as is charged in the previously advantaged suburbs of Richard's Bay" (Flynn and Chirwa 66). The policies in place limit equitable access and distribution of water within poor, predominantly black townships, whereas affluent suburban neighbourhoods continue to afford substantial amounts of water.

Policies of race-based segregation in service delivery such as education and infrastructure maintenance, as well as unequal wage distribution and a racialized labour sector instutionalized under the apartheid regime; created static inter-racial inequalities. Post-apartheid South Africa has shifted to include increasing intra-racial inequalities, predominantly in South Africa's black population. Although contested, according to a report Statistics South Africa released in 2002, the "average black 'African' household income declined 19 per cent from 1995 to 2000, while white household income was up 15 per cent" (Bond "Globalization" 345). Furthermore, policies following the neoliberal trajectory such as de-agrarianization have contributed to inter- and intra-racial spatial polarization as unequal distribution of wealth, resources, and opportunities persist (Burgard 569; Bond "Globalization" 345 – 347; Gualtieri 1; Muiu 253).

Privatization facilitates the reinstitutionalization of basic water service stratification by implementing mechanisms to control and limit the use of water for those who cannot afford water service payments. Cost recovery measures include drastic consequences such as "repossessing houses, water cut-offs, prepaid meters and drip-valves that restrict water supply to the poor" (McDonald and Ruiters 14). I focus on South Africa's Free Basic Water policy and water cutoffs to illustrate the

250 *World City Syndrome*

Table 7.3 Minimum Estimated Daily Water Needs in South Africa (per person)

Water Use	*Estimated amount of water required (litres)*
Wash basin (instead of shower or bath)	10
Toilet (2 flushes)	26
Handwashing	8
Drinking	5
Food preparation	1
Washing of dishes	3
Washing of clothes	7
General housecleaning	3
TOTAL	63
Shower (instead of washbasin)—3 per week @ 100 litres per shower	42
TOTAL (Minus washbasin)	95
Bath (instead of washbasin)—2 per week @ 200 litres per bath	57
TOTAL (Minus washbasin)	110

Note: The above calculations exclude the special water needs of the very young, the old and the sick. They also make no allowance for the water needs of subsistence fruit and vegetable gardens.

Source: Data provided by Jeff Rudin, Research Officer, Samwu, July 10, 2005.

Figure 1. Minimum estimated daily water needs in South Africa (per person). Does not include water needs for subsistence fruit and vegetable gardens (McDonald).

paradoxical effects of attempts at water service redistribution. Enshrined in South Africa's Department of Water Affairs and Forestry's (DWAF) Free Basic Water policy (2000), the free amount of water of fifty litres per person per day or six thousand litres per household per month is only a 'lifeline' of "two toilet flushes a day for a house-

hold of eight" (Bond 350).

The required amount of water is insufficient to uphold needs of individuals and households (see Figure 1), many of whom live in poor, predominantly black townships, districts or communities (Bond "Globalization"; McDonald and Ruiters 26).

In response to the 'lifeline' policy, block tariffs – a form of cost recovery – were designed as water resource redistribution mechanisms by means of cross subsidization from the wealthy to the poor (McInnes 100-101; Smith 383-390). This tariff structure adversely affects low-income households as the price of water rises substantially after the initial free six thousand litres is consumed (McInnes 99). Designed as a consumption-based charge, the tariff policy fails to consider that many low-income households, especially in townships, are comprised of fifteen to thirty people sharing a single water source. An inheritance of apartheid, the highest poverty rates in cities coincide with the densest households in townships. Due to urban spatial inequalities, the block tariff structure subsequently increases the cost of water for urban low-income households with more than four to five people (Smith 385). The inability to pay for water service delivery obligates many South Africans to use dirty water or allocate water from a distant source. Further consequences such as cholera outbreaks, the facilitation of HIV progressing into AIDS (Bond "Globalization") and other detrimental health effects precipitate (CAWP). Implementation of mechanisms to control and limit the use of water are increasingly widespread, and those who cannot afford the water service payments endure water disconnections.

Though five million households gained access to clean water between 1994 and 2000 (Miraftab 879; WHO), water disconnections illustrate the insurmountable price of water hindering low-income households' ability to afford payments. One measure, amongst others, advocated by the World Bank to ensure cost recovery for corporations and companies providing water ser-

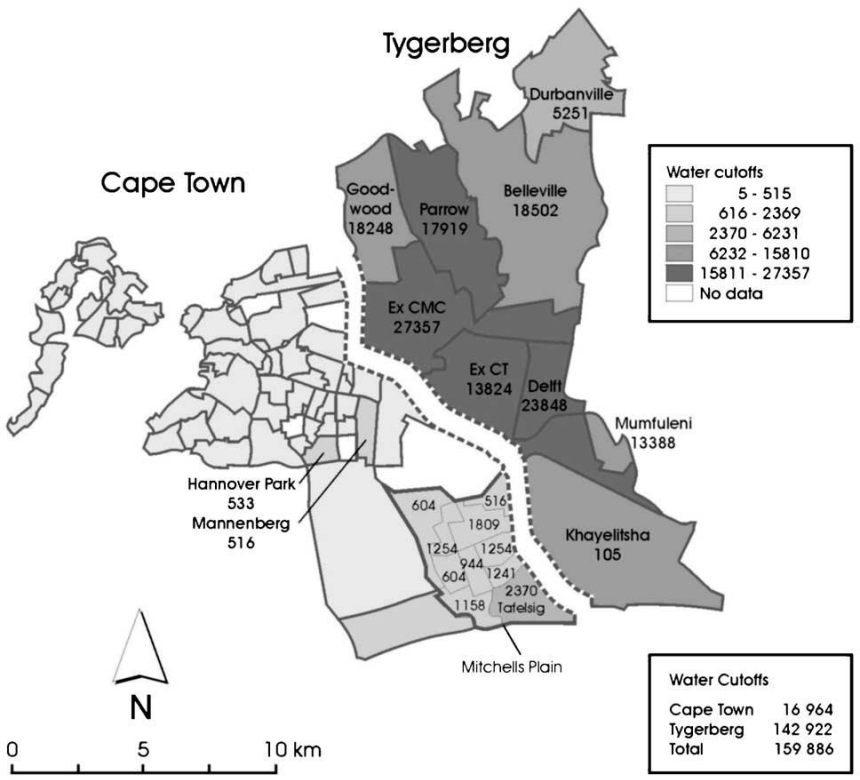

Figure 2. Total water cutoffs in the Capetown and Tygerberg administrations (1999-2001) (Smith and Hanson 1534).

vices, is by means of water disconnections if the receiver fails to pay the bill (McInnes 100-101). Despite the introduction of the Free Basic Water policy in 2001, millions of low-income South Africans have been deprived of a primary life source since 1994 (see Figure 2). Cut-offs last for weeks or months. Additionally, over two million have experienced evictions. Between 1994 and 2002, service disconnections affected up to 9.8 million individuals (McDonald). During the eight-year period from 1996 to 2004 Cape Town cut water service to an estimated 92,772 poor households, amounting to approximately 463,000 individuals. During six months in 2000, Cape Town's black township of Khayelitsha suffered 14,355 household water disconnections (Miraftab 878-879). Collectively, more than ten million South Africans have experienced disconnections from their primary water source (CAWP). Though successes of water distribution positively affect some South African lives, the numbers do not do justice to the millions that have been, and continue to be, deprived of this constitutional, and as some argue, basic human right.

Conclusion

The neoliberalization of the water distribution system in South Africa remakes inequalities, and undermines efforts to disable imbalances produced during apartheid. Privatization is thus a regeneration of unequal access to services, and a polarization of space, which further entrenches inequalities within race and differentiated spaces, and deprives many of a primary life necessity. Spiraling into a descending cycle of poverty and compromised health, remnant of the apartheid past, water privatization is at the expense of the poor. The cycle grasps those who feel the brutal front of neoliberal water policies, as privatization encroaches upon and inhibits equitable distribution of water by limiting access or cutting service. It is therefore just to state, "privatization of water and sanitation service delivery may result in improvements in infrastructure but, in a context of high levels of poverty and major political transformation, is unlikely to result in affordable, sustainable and developmental outcomes for low income communities" (Gillet et al. 145). Looking at everyday life transformations of post-apartheid South Africa, it is evident that spatial implications of wealth disparity reside in the inequalities perpetuated by water privatization—neoliberalism has indeed produced 'water apartheid' in South Africa.

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ACCESSING VANCOUVER'S PRIVATELY OWNED PUBLIC SPACES

George Rahi, Andrew Martynkiw, and Emily Hein.

Abstract: *Our research project investigates privately owned public spaces in the city of Vancouver. With the emergence of public-private partnerships as a widespread form of urban development, the provision of public space has increasingly relied upon private owners and managers. Taking inspiration from Jerold Kayden's work on New York, we document various privately owned public spaces, in the form of the urban plaza, across the downtown core of Vancouver. Our study makes multiple inquiries into the social life of these public spaces, as influenced by their design and management. A historical analysis of the policy context in which these spaces were negotiated by city official and developers is followed by an assessment of the public spaces themselves using observational research techniques. The assessment is comprised of two parts: (1) a survey of the physical attributes of these spaces, categorized as either encouraging or discouraging accessibility and use, and (2) observations on the social life of the spaces we visited.*

Introduction

Public spaces are a multifaceted and complex object of study. Their objective and physical qualities are bound up with their socially heterogeneous functions. They are a site of both fleeting and enduring social relations, and provide the foundation for a wider, convivial urban community. Many scholars have lamented the death of truly 'public' space (Sennett), and it is certainly true that the character of public spaces has been transformed immensely in North American cities (Sorkin). Privatization, commoditization, and increased surveillance are increasingly common practices of city governments, developers, and corporate sponsors in their efforts to produce a cleansed and selective public sphere for the broader goals of consumption and control. In Vancouver, British Columbia the continual overlaying of historically specific rounds of urban development has produced a series of networked and isolated publically accessible places that have gone largely unexamined by any systematic study. Of particular interest is the vast array of privately owned public spaces (POPS) across the central business district (CBD). For a city whose downtown core has undergone immense residential densification (the downtown population has more than doubled since the late 1980s), many of these spaces no longer exist in the context of the 9am to 5pm work schedule for which they had been designed. The image of the office worker on lunch break has been supplanted by a much more mixed and flexible population of workers and consumers alike. Public spaces are now much more likely to be host to playful events such as flash-mobs and urban sports in addition to their more traditional roles as places for social movements, ceremonies, celebrations, and free speech. We are not alone (Vancouver Public Space Network) in our observation that Vancouver's downtown lacks many central gathering places so crucial for a democratic, civil society (Berelowitz). Rather, what abounds is a series of small and fragmented public spaces, many

of which are hostile to public use. What follows is an attempt to situate a sample of these POPS within a systematic framework that investigates the very notion of 'publicness' itself. Our research is an effort to comprehend the various social, political, and economic processes that create these spaces, and the ways in which the geography of these POPS influences the urban fabric.

Theories of Public Space

As an object of study, public space has increasingly proved integral to theories of urban development, the state, social movements, communication and social justice. Because the notion of 'public space' has many contrasting definitions, a precise one may prove elusive. An objectivist, external view of public spaces as physical entities 'out-there' contrasts with a social constructivist view which posits that public space is an outcome of individual and collective activities by agents who deem a space as public (Carmona et al. 137). For whom then is a space public? Iris Young argues that it would be false to presume a unitary public realm; rather, she holds that there exists a series of overlapping public realms, or 'multiple publics' (qtd. in Carmona et al. 140). We propose the viewpoint that an understanding the social production of public space must not neglect the materiality of public space, lest we forfeit our ability to engage in clear empirical analysis of the spatiality of public life.

Of equal importance to definitions of 'public space' is its opposite: 'private space' or 'private property'. Public space is dialectically related to private property, whereby 'publicness' is produced through a process of private property owners 'freely' joining together to create the public sphere through state provision (Mitchell 132). This prerequisite of private property ownership and freedom of association, argues Mitchell, constructs the notion of 'public' as meaning "having access to private space to retreat to (so that publicness can remain voluntary)" (132). Obviously, not everyone has the privilege of retreating to a private space, and thus the legitimacy of public space as an outcome of private property relations is compromised. For Mitchell, homeless people threaten to "expose the existence of the 'legitimate' – that is, voluntary – public as a contradiction if not a fraud; voluntariness is impossible if some are necessarily excluded from the option of joining in or not" (135). To expand on Mitchell's insights and move beyond the notion of public and private space as clearly separable (occupying opposing realms in the legal-property sense), we argue that public space and private space differ not just in terms of ownership, but also along a spectrum of accessibility and openness. The extent to which a space is 'public' is furthermore contingent on users actively claiming it as such. The transparent barber shop, the local cafe, and shopping mall represent grey areas of the public/private distinction, where both private and public activities co-exist mutually. For our purposes, we do not include these publicly accessible spaces, referred to as "third spaces" in our analysis (Oldenburg). While most of these third spaces come with the expectation/obligation of consumption, the corporate and civic plazas that we have chosen to study differ in that they represent a taken-for-granted portion of Vancouver's public space that is largely disassociated from direct consumption activities (i.e. no user fee is required).

Like many cities, public space in Vancouver is diverse and covers a spectrum ranging from squares, plazas, waterfronts, sidewalks, parks and indoor spaces such as atriums. We located the outdoor urban plaza as a common and notable example of privately owned public spaces. They are ubiquitous to the urban dweller, and constitute a large proportion of public, 'open space'. We created a list of all 31 plazas in the CBD, 24 of which are privately owned (Figure 1). The remaining seven spaces can be divided into civic plazas (Library Square North and South, and Vancouver Art Gal-

lery North) and plazas managed by publicly-owned corporations (CBC Plaza, Canada Place, and Jack Poole Plaza). These spaces function as primary nodes of public life within the core of the city.

Zoning and Public Space in Vancouver

Vancouver's corporate plazas are the outcome of an informal, case-by-case process similar to the practice of 'incentive zoning' pioneered in cities such as New York and San Francisco. Incentive zoning sees city agencies leverage the ability to control zoning regulations such as height restrictions to secure public amenities from property developers. When developers seek to maximize their building's density above current height restrictions, city agencies such as Vancouver's Urban Design Panel and the Development Permit Committee negotiate lifting restrictions in exchange for urban amenities such as plazas, recreation space, and art installations financed by the developer. From 1989 onward, this process became codified into the Vancouver Community Benefit Agreements and Community Amenity Contributions (Punter 105). However, most plazas date back to the 1970s and 1980s, when more informal negotiations were made on the count of Floor Space Ratio units, also known as Floor Area Ratios. Prior to 1989, the Zoning and Development By-Law of 1957 (No. 3575), which references the Technical Planning Board's ability to permit buildings to rise above height limits on the basis of providing adequate set-backs, gave city planning officials a large amount of discretion for each major development. As Jerold Kayden notes, "The social rationale for this exchange is that the public is better off in a physical environment replete with public spaces and bigger buildings than in one with fewer public spaces and smaller buildings" (177). For the public, these privately provided public spaces serve to offset the negative impacts of increased density, such as street congestion, pollution, and loss of sunlight. For developers, the trade-off is economical, as the increases in land value usually exceeds the cost of providing the public space (Kayden 177). These density bonuses are responsible for all kinds of spaces: plazas, sidewalk widening, open-air concourses, and others. In most cases, private owners legally cede the right to exclude others from these spaces, but in practice this is not always the case. The degree to which these spaces are public is thus further contingent on the management practices of the private owner. Owners have various motivations for controlling who uses these spaces and for what type of activity, such as, "their responsibility for maintenance, their liability for what may happen within the space, and their concern for marketability" (Carmona et al. 154).

Figure 1. Map of Vancouver's public and privately owned public spaces in the CBD. Source: Alex Leckie, UBC Geography Department.

Toolkit for Studying Pubic Spaces

To measure the 'publicness' of privately owned

public spaces in Vancouver, we have implemented an index developed by Németh and Schmidt in New York. Their index is premised on the question of whether private provision of publicly accessible spaces "reduces the publicness traditionally associated with it" ("The privatization of public space" 12). It is also recognized that successful public spaces strike a balance between liberty and security ("Toward a Methodology" 280). Németh and Schmidt propose that 'publicness' can be assessed according to three core components: ownership, management, and uses/users ("Toward a Methodology" 281). Their index was developed in consultation with various planners and urban designers, and is divided into four major dimensions: (1) laws and rules governing the space; (2) surveillance and policing present in the space; (3) design and image-building techniques to both literally and symbolically dictate appropriate behaviour; and (4) access restrictions and territorial separation to control space. Each dimension covers a number of indicators of material practices and design features utilized in making spaces more or less controlled. The twenty indicators are separated into two groups, ten of which signify practices that encourage use, and ten which signify practices that discourage use of spaces.

Index Results for Vancouver's POPS

Using Németh and Schmidt's index, we calculated a score for each space based on the twenty indicators. The scoring criteria for indicators in the section 'Features that control uses' are weighted negatively (i.e. 0, -1, -2) while the scoring criteria for indicators under the section 'Features that encourage use' are weighted positively (see Table 1 in Appendix A). These twenty indicators are detailed in Table 2 (Appendix B). The lowest score a space can receive is -20 (meaning most restricted) and the highest score is +20 (meaning least restricted). Our results are given in Table 3(Appendix C).

Our results reveal substantial differences between corporate and civic plazas. While we do not have a sufficient sample size to compare corporate and civic plazas using statistically rigorous methods, the range of scores indicate a surprising amount of variability between plazas. The average score for POPS was (+1), while the average score for publicly owned plazas was (+7.5). POPS differed most from publicly owned spaces in that they were under more surveillance by cameras and guards, had fewer accessible washrooms, and provided less lighting, art, and cultural enhancement. However, it should be noted that ownership alone cannot account for whether a plaza is an inclusive public space or not, as our survey identifies five POPS with scores of (+5) and more.

Assessing these spaces using the index above enabled us to more reliably assess the spaces on objective terms. Because Németh and Schmidt's index was focused more heavily on physical design features, we felt it was necessary to combine it with a social survey to allow us more insight into how these POPS actually perform in terms of user behaviour. Using observational methods, the social survey gave us insights into how people use these spaces, how long they used them for, and for what purposes. We documented three spaces – Waterfront Centre, Cathedral Square, and the Shangri-La Plaza – on three different days to produce a total of 3 hours of records for each space. Each site was visited at noon on a weekday, at 5pm on a weekday, and at noon on a weekend.

The discussion of our social survey results which follow is highly influenced by William Whyte, who is well known for his extensive observational studies of public spaces (Whyte). Whyte highlights that many public spaces, the civic and corporate plaza in particular, provide the opportunity for citizens to express and negotiate a sense of civic identity. Compared to sidewalks which have a sense of shared/common public space, these spaces can be viewed as eddies or pockets of relief. This is what Matt Hern discusses in terms of differ-

entiating public space from common space when he states, "People move through public space – but common space is where they stop, what they learn to inhabit, and make their own" (59). This involves creating spaces that do not elicit or demand specific behaviour. Whereas the primary purpose of sidewalks is to move people from one place to another, common spaces play an active role as meeting places, facilitating "face-to-face meetings and the surprising and unpredictable character of experiences" (Gehl 26). These unpredictable spaces, where people are able to engage with what Hern describes as encounters with the "other" and the unexpected (154), are critical in allowing a sense of civic identity to emerge. More so, in a social and built environment that is increasingly changing as buildings are demolished and re-constructed to serve different functions French notes that, "public spaces tend to remain relatively constant and unchanging through time" (21). Thus, as the built form continues to change rapidly in the downtown core, public spaces provide citizens with a sense of continuity, reliability, and predictability through time.

By observing the ways in which people entered the spaces at Waterfront Centre, Cathedral Square, and Shangri-La Plaza, we were able to discern, to a degree, their level of accessibility. People typically size up new situations quickly to figure out who is there, what is happening, and what might happen next (Cialdini 12). These judgements help people navigate new spaces when the rules of what is socially acceptable are not explicitly given. Thus, the perceived accessibility of a space becomes crucial to the initial judgments people make regarding how public a space feels, and thus, in determining their likeliness of using the space. If no rules are apparent to dictate how a space should be used, the individual must rely upon the rest of the public for cues, and if the space is not populated then private security becomes the default source of information (Gehl 210). However, when people entering a POPS are primed with a sign stating that the space is for public use, they are likely to feel less tension from the presence of security guards and more personal autonomy. As Jan Gehl notes, "Security and the ability to read a situation are reinforced when social structures are supported by clear, physical demarcations" (102). One of our recommendations is that Vancouver would benefit from signage declaring its POPS for public use. A similar initiative to sign its privately owned public spaces has been taken by the city of Seattle, Washington an example of which is shown in Figure 2 below.

Social Survey Observations:

Waterfront Centre (200 Burrard St)

The Waterfront Centre, situated across the street from the Vancouver Convention and Exhibition Centres, serves as a transport hub, and as a major centre for shopping, hotels, and offices. Inside and below the main floor of the building there is also a food court connected underground to other buildings that serves business people, tourists coming off cruise ships, and conference delegates. The main entrance to the space on the southwestern corner has a transparent glass wall making the security guards inside visible from the street. Outside, massive colonnades descend in

Figure 2. Public Space sign in Seattle. Source: Adrian Martynkiw.

a semi-circle as structural supports for the building, creating a large space outside with protection from the rain. The design of the open space is relatively plain. White stone barrier walls zigzag through the middle of the space serving as seating backed by glass barriers that divide the open from a few patches of grass that make up a about a third of the space itself. Planters less than a few feet from the ground occupy a large portion of the open space exposed to the elements. Although most of the seating faces the skyscraper, there are great views of the North Shore.

Shangri-La (1121 Alberni St)

The Shangri-La is currently the tallest building in Vancouver, providing space for a hotel on the first 12 floors with the rest fitted for high-end condos. Pedestrians engage with the building on the street level through its glass hotel lobby, a boutique food store, and public open space which includes a public art installation by the Vancouver Art Gallery. The public open space is minimally landscaped, provides no seating despite ample space for it with protection from rain, and serves primarily a conduit for pedestrian movement between Georgia and Alberni Street. Vegetation is planted either one floor below on the parking level protruding up into the space, or is located up the flight of stairs leading up the designated bar and lounge areas. These design features may be due to the fact that the Shangri-La's plaza was not factored into the developer's Community Amenity Contributions. Rather, just enough space for the art installation was given along with payments for heritage restoration of the Coastal Church next door. No amenities were provided on or off-site for lower-income members of the community. Thus, the Shangri-La reveals how the practice of up-zoning for increased density ensures and enhances developer profitability with a selective package of benefits targeted at a specific, more affluent public.

Cathedral Square (596 Richards St)

Located along Dunsmuir St. across the street from the 110 year old Holy Rosary Cathedral, Cathedral Square is comprised of two distinct areas. Accessibility along the entire southern entrance is via the sidewalk so pedestrians walking by need not worry about making a decision as to whether they wish to enter the space. The streetscape seamlessly blends in, and the seating is laid out in a semi-circle facing the church across the street. Throughout the rest of the space there is ample seating arranged in a variety of orientations. The fountain in the centre of the space acts as a psychological and physical divider of the space. Trees along the perimeter provide protection from the rain for some seating, and there is a grassy area near the front that could comfortably accommodate a group of individuals wishing to sprawl on the grass. In contrast to the other spaces described above, Cathedral Park is not directly adjacent to any buildings and therefore does not imply any specific function. The north side of the space was originally equipped with a large glass awning that provided protection from the rain. This is supported by massive bollards that draw the eyes of exploring individuals who wish to see what lies ahead. During the 1990s, the glass paneling was removed after homeless people began using the space at night. Currently, only the awning's bulky steel skeleton remains, with the glass paneling having been removed along with the seating below. What is unique about this case is that a comfortable space was initially provided and then revoked, due to fear of 'undesirables'. William H. Whyte took note of the way this fear operates in his description of the purposeful hardening of spaces in New York, as justified by fears that homeless people would take advantage of it (36). The result is a hardened, underutilized place where it easier for deviant activities to take hold. The north end of Cathedral Square is now commonly used for intravenous drug-use. Perhaps this would be different if the space's comfortable

amenities had been left intact; the collective eyes of the community that would have resulted from its active use would likely have been sufficient to regulate it.

Conclusion

Public spaces are pivotal to the daily course of people's lives. Whether as a respite from the hustle and bustle of the automobile-dominated streetscape, a space for moments of reflection, or a place to connect with others, public spaces are the last vestiges of an urban commons. The existence of privately owned public spaces complicates the neat binary between public and private, as they combine elements of private ownership, securitization, rules and restrictions, with publicly accessible amenities such as shelter and seating. For many of the plazas we visited, design features that discouraged use tended to prevail over features that encouraged use. Our observations from the social survey suggest that many of these POPS were designed more as spaces for movement into their respective buildings, with the public nature of the space seemingly an afterthought of development. The social survey, though limited in scope, indicated a paltry number of actual users of Shangri-La and Waterfront Centre public spaces. The exception is Cathedral Square, which we view as a well-designed public space that provides inviting seating. Whyte's incredibly simple observation that "people tend to sit where there are places to sit," is as true now as it was then (16). The developers of Shangri-La and Waterfront Centre plazas stubbornly (or intentionally) ignore Whyte's observations, to the detriment of the social life of the space, whereas Cathedral Square is more inclusive as a result of its well-designed public seating area. After assessing Vancouver's POPS using the index and the social survey, we began to recognize what was absent from these spaces. What can be inferred from the absence of people and the silence of their activities? In recognition of the fact that Vancouver is often reduced to the stylized "Vancouverism" of the waterfront mega-projects in Yaletown and Coal Harbour, we would like to avoid essentializing Vancouver's public realm by adding that our study is confined to a very specific local context. A comparison between public spaces in the CBD and other peripheral downtown areas would likely produce different results. One thing is clear, the arguments made throughout our research is not the first critique of Vancouver's downtown POPS. Frederick Brookes, a practicing architect during the 1970s, made the following astute observation:

"[Today] the general trend by more progressive developers is towards landscaped plazas, court spaces and roof-scapes which are integral parts of the development….while things have begun to change in a visual way, little progress has been made to improve the social function of the city landscape. In Vancouver we have become used to a downtown that discourages participation: we are not allowed opportunities for creative loitering; we are overprotected against injuring ourselves from everything but the automobile; we are warned to keep off or keep out by barriers and signs; and there are no sculptures or other structural design elements in the downtown area that can be used functionally. Many restrictions need to be changed so that improved people participation in downtown and other densely developed areas can be encouraged. (qtd. in French 152)

One might speculate as to which restrictions Brookes is referring to; there are many conclusions to be drawn from the array of uninviting and over-protected POPS. An explanation attributing barren plazas to mere poor design quality on behalf of architects would be insufficient; there is also the developer's drive to save money by underinvesting in the space as well as the building manager's interest in lightening their workload by discouraging use. Because of the considerable influence developers have over the design process, it would be naïve to presume that the creation of an

inviting public space was a priority for all parties (Smithsimon 128). Clearly, there has been a long-running scepticism of the 'publicness' of Vancouver's POPS. In 1984, a study of downtown plazas was undertaken by planning consultants Robert Buchan and Larry Simmons in cooperation with staff from Vancouver's Social Planning Department. Their report confirmed the "growing recognition that the open space plazas which have been provided by major downtown developments have not always been successful people places" (Buchan and Simmons i). The municipal report concludes, "Because these open spaces are important urban amenities, it is considered that unsuccessful plazas are a waste of precious public spaces and opportunities" (i). Indeed, POPS only contribute to the social life of the downtown environment to the extent to which they are used. Unfortunately, their assessment did not make much of an impact on the city's public space policies, as it took another decade for city council to implement their first Plaza Design Guidelines document in 1994. Even then, the guidelines failed to specify any hard measures for creating successful people-places, and moreover, the downtown office boom had long passed (Punter 284).

The Vancouver Public Space Network and the City of Vancouver's Planning Department are currently in the process of formulating a new Downtown Public Space Plan. Based on our findings, we have the following recommendations: (1) strengthen plaza design guidelines as part of a larger updated policy on publicly and privately owned public spaces, and include public input to determine desired social functions; (2) require plazas to install signage declaring the space for public use; and (3) require existing POPS to conform to higher standards through renovations. Our public spaces should reflect our democratic ideals as a society and encourage participation by all people. Our study of Vancouver's urban core suggests the need to reconsider the design, creation and management of privately owned public spaces in this city to make our public spaces successful people places

Appendix A

	Dimension	Scoring Criteria
Features that control users		
Visible set of rules posted	Laws and Rules	0 = none present
		1 = one sign or posting
		2 = two or more signs
Subjective judgment/rules posted	Laws and Rules	0 = none present
		1 = one rule visibly posted
		2 = two or more rules visibly posted
In Business Improvement District	Surveillance and Policing	0 = not in BID
		1 = in BID with maintenance duties only
		2 = in BID with maintenance and security duties
Security cameras	Surveillance and Policing	0 = none present
		1 = one stationary camera
		2 = two or more stationary cameras or any panning/moving camera
Security personnel	Surveillance and Policing	0 = none present
		1 = one private security guard or up to two public security guards
		2 = two or more private security guards
Secondary security personnel	Surveillance and Policing	0 = none present
		1 = one person, or space oriented towards reception
		2 = two or more people, or one person with space oriented toward reception
Design to imply appropriate use	Design and Image	0 = none present
		1 = only one or two major examples
		2 = several examples throughout the space
Presence of sponsor advertisement	Design and Image	0 = none present
		1 = one medium sign or several small signs
		2 = large sign or two or more signs
Areas of restricted or conditional use	Access and Territoriality	0 = none present
		1 = one small area restricted to certain members of the public
		2 = large area for consumers only or several smaller restricted areas
Constrained hours of operation	Access and Territoriality	0 = open 24 hours a day, seven days a week, most of the year
		1 = at least part of space open past business hours and on weekends
		2 = only open during business hours or portions permanently closed
Features encouraging freedom of use		

Sign announcing "Public Space"	Laws and Rules	0 = none present
		1 = one small sign
		2 = one large sign or two or more signs
Public ownership or management	Surveillance and Policing	0 = privately owned and privately managed
		1 = privately owned and publicly managed
		2 = publicly owned and publicly managed
Restroom available	Design and Image	0 = none present
		1 = available for customers only or difficult to access
		2 = readily available to all
Diversity of seating types	Design and Image	0 = no seating
		1 = only one type of stationary seating
		2 = two or more types of seating or many movable seats
Various microclimates	Design and Image	0 = no sun or no shade or fully exposed to the wind
		1 = some sun and shade, overhangs, or shielding from wind and rain
		2 = several distinct microclimates, extensive overhangs, trees
Lighting to encourage nighttime use	Design and Image	0 = none present
		1 = one type or style of lighting
		2 = several lightings (e.g. soft lighting, overhead, lampposts
Small-scale food vendors	Design and Image	0 = none present
		1 = one basic kiosk or stand
		2 = two or more kiosks/stands or one larger take-out stand
Art, cultural, or other visual enhancement	Design and Image	0 = none present
		1 = one or more minor installations, statues or fountains
		2 = one major interactive installation, statue or fountain
Entrance accessibility	Access and territoriality	0 = gated or key access only
		1 = one constricted entry or several entries through doors/gates only
		2 = more than one entrance without gates
Orientation accessibility	Access and territoriality	0 = space not visible and oriented away from public sidewalk
		1 = space visible but oriented away from public sidewalk
		2 = space visible and oriented towards public sidewalk

Table 1. Scoring criteria for indicators listed in Németh and Schmidt's Index for assessing the accessibility of public spaces. Source: Németh and Schmidt. "Towards a Methodology for Measuring the Security of Publically Accessible Spaces." Journal of the American Planning Association 73.3 (2007): 279-283.

Appendix B

Features that control users	
Laws and Rules	
Visible set of rules posted	Official, visible signs listing sets of rules (not individual rules) on a permanent plaque. Rules should generally be objective and easily enforceable, like prohibition against smoking, sitting on ledges, passing out flyers without permit, or drinking alcohol.
Subjective judgment/rules posted	Official, visible signs listing individual rules describing activities prohibited after personal evaluations and judgments of desirability by owners, managers, or security guards. Such rules might include: 'no disorderly behavior', 'no disturbing other users', 'no loitering', 'no oversize baggage', or 'appropriate attire required'.
Surveillance and Policing	
In Business Improvement District	Spaces located in Business Improvement District (BID) are more likely to have electronic surveillance and private security guards, and less likely to include public input into decisions regarding park management. BIDs can employ roving guards to patrol especially problematic neighbourhood spaces
Security cameras	Although camera must be visible to the observer to be counted, many cameras are hidden from view. Cameras are often located inside buildings or on surrounding buildings but are oriented toward space. Stationary cameras are more common, and often less intimidating than panning/moving cameras.
Security personnel	Scoring dependent on time of visit. Publicly funded police, park rangers, private security guards. For index, score only when security is dedicated to space. Since private security guards are directed only by the property owner, these can be more controlling (and score higher on index), since police are trained more uniformly.
Secondary security personnel	Scoring dependent on time of visit. Includes maintenance staff, doorpersons, reception, café or restaurant employees, bathroom attendants. Also, spaces often oriented directly toward windowed reception or information area to ensure constant employee supervision.
Design and Image	
Design to imply appropriate use	Small-scale design to control user behavior or to imply appropriate use. Examples might include metal spikes on ledges; walls, barriers, bollards to constrict circulation or to direct pedestrian flow; folded, canted, or overly narrow and unsittable ledges; or crossbars on benches to deter reclining.
Presence of sponsor/advertisement	Signs, symbols, banners, umbrellas, plaques tied to space's infrastructure, and not to immediate services provided (e.g. cafes, kiosks). While non-advertised space is important for seeking diversion from city life, sponsored signs/plaques can push sponsors to dedicate resources for upkeep since company name is visible.
Access and Territoriality	
Areas of restricted/conditional use	Portions of space off-limits during certain times of day, days of week, or portions of year. Can also refer to seating tables only open to café patrons, bars open only to adults, dog parks, playgrounds, corporate events open to shareholders only, spaces for employees of surrounding building only.
Constrained hours of operation	While some spaces are permitted to close certain hours of the day, spaces not open 24 hours inherently restrict usage, and clearly prioritize employee use over use by the general public.
Features that encourage freedom of use	
Laws and Rules	
Sign announcing public space	Most zoning codes require publically accessible space to exhibit plaques indicating such. Some spaces are clearly marked with signs denoting their public nature (e.g. New York's Sony Plaza), but when a sign or plaque is hidden by trees or shrubs, or has graffiti covering it, its intent becomes null.
Surveillance and Policing	

Public ownership/management	Could fall under Laws and Rules, but more likely to impact type/amount of security and electronic surveillance in a space. Management often by conservancy or restoration corporation. Spaces can be publically owned and managed, publically owned and privately managed, or privately owned and managed.
Design and Image	
Restroom available	Clearly some spaces are not large enough to merit a public restroom. Realizing that free public restrooms often attract homeless persons, managers often remove them altogether, or locate them in onsite cafes or galleries available to paying customers only (or providing keyed access for 'desirable' patrons only).
Diversity of seating types	Amount of seating is often most important factor for encouraging public use of space. Users often evaluate entry to space based on amount of available seating and ability to create varying 'social distances'. Movable chairs allow maximum flexibility and personal control in seating choice.
Various microclimates	Spaces with various microclimate enclaves broaden choice and personal control for users. Potential features might include shielding from wind, overhangs to protect from rain, areas receiving both sun and shade during the day, or trees/shrubs/grass to provide connection with the natural landscape.
Lighting to encourage nighttime use	Studies indicate the vulnerable populations often avoid public spaces at night if not well lit. Lighting spaces encourages 24 hour use, and has been shown to make users feel safer/more secure. However, critics argue that night lighting aids surveillance efforts and implies authoritative control.
Small-scale food consumption	Most agree that vendors enhance activity and vitality. This variable only includes small cafes, kiosks, carts or stands selling food, drinks, or simple convenience items. Sit-down restaurants, clothing stores, or other full-scale retail establishments are not described by this variable.
Art/cultural/visual enhancement	Art and aesthetic attraction can encourage use. Variables can include stationary visual enhancements like statues, fountains, or sculptures, and also rotating art exhibits, public performances, farmer's markets, and street fairs. Interactive features encourage use and personal control by curious patrons (often children).
Access and Territoriality	
Entrance accessibility	If a space has locked doors or gates, requires a key to enter, or has only one constricted entry, it often feels more controlled or private than one with several non-gated entrances. In indoor spaces where users must enter through doors or past checkpoints, symbolic access and freedom of use is diminished.
Orientation accessibility	Spaces must be well-integrated with the sidewalk and the street, as those oriented away from surrounding sidewalk, or located several feet above or below street level make the space less inviting. Well-used spaces are clearly visible from the sidewalk, and users should be able to view surrounding public activity.

Table 2. Indicator definitions according to Németh and Schmidt's Index for assessing the accessibility of public spaces. Source: Németh and Schmidt. "Towards a Methodology for Measuring the Security of Publically Accessible Spaces." Journal of the American Planning Association 73.3 (2007): 279-283.

Appendix C

Location	Score	Location	Score
1. 601 West Hastings St. (Seymour Plaza)	5	17. 901 West Hastings St.	5
2. 111 Dunsmuir St. (Stantec Plaza - Now Amec)	4	18. 250 West Waterfront Rd. (Canada Place)	-2
3. 333 Dunsmuir St. (BC Hydro Plaza)	3	19. 200 Burrard St.	-7
4. 608 Hamilton St. (Queen E Plaza)	4	20. 555-595 Burrard St. (Bentall Centre II/III)	-1
5. 700 Hamilton St. (CBC Plaza)	4	21. 1140 West Pender St.	8
6. 596 Richards St. (Cathedral Park)	6	22. 1138 Melville St.	3
7. 401 West Georgia St. (BMO Plaza)	-4	23. 1100 Melville St.	7
8. 350 West Georgia St. (Library Square North)	8	24. 1075 West Georgia St.	-3
9. 350 West Georgia St. (Library Square South)	7	25. 1040 West Georgia St.	2
10. 700 West Georgia St.	1	26. 1055 West Hastings St.	-3
11. 750 Hornby St. (Vancouver Art Gallery Plaza)	6	27. 1066 West Hastings St.	-4
12. 701 West Georgia St. (Pacific Centre Plaza)	-3	28. 1055 Dunsmuir St. (Bentall I Plaza)	4
13. 850 Burrard St.	-1	29. 639 Hornby St. (Cathedral Place)	-2
14. 666 Burrard St. (Park Place)	1	30. 200 Granville	-3
15. 550 Burrard St. (Bentall 5/Cactus Club Plaza)	-1	31. 1121 Alberni St. (Shangri-La Plaza)	-1
16. 510 Burrard St. (Scotiabank Plaza)	1		

Table 3. Selection of Vancouver's public spaces scored according to Németh and Schmidt Index. Positive scores indicate higher accessibility, while negative scores indicate lower accessibility. Adapted from: Németh and Schmidt. "Towards a Methodology for Measuring the Security of Publically Accessible Spaces." Journal of the American Planning Association 73.3 (2007): 283-279

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Sustainable Development in a Globalized World

A NEW GREEN REVOLUTION: A REVIEW OF AGRICULTURAL REFORM IN SUB-SAHARAN AFRICA

Knut Tjensvoll Kitching

Abstract: *The Green Revolution in Africa represents a set of agricultural reforms driven by technological innovations such as High Yield Varieties of seed, fertilizers and complex irrigation regimes. Though perceived as a panacea by major development banks and governments, the Green Revolution has not always enjoyed success in the Global South. This paper reviews some of the current agricultural reforms that form key dimensions of the Green Revolution policy regime, and considers some outstanding critiques of its application in sub-Saharan Africa. The paper opens with a consideration of the key reforms associated with the Green Revolution, and then moves to a discussion of seed technologies, land rights and tenure, and trade and social policy. Situating these debates within a larger regional context of shifting climate and ecological change, this paper aims to present a critical examination of some of the primary goals and projects of the Green Revolution in Africa and concludes that the way forward traces a line between Western techno-scientific reforms and uniquely African approaches to agriculture.*

Introduction

The current vision of the Green Revolution as a development model is in many respects one that is based strongly in the vision that emerged in an Asian context beginning in the 1960s and 1970s. This 'original' model deemed agricultural practice in many 'third world' settings to be inefficient and in need of western expertise and technology. Technological innovations in agriculture were perceived as a panacea which would solve the problems of rampant poverty and hunger. However, since those early applications it has come to be understood that not only are problems of hunger often far more complex than simply a deficit of food (Devreux 118), they are also questions of agricultural 'inefficiency' that cannot be solved simply by the addition of fertilizers and pesticides and the use of new genetically engineered seeds.

This paper will consider several subtopics within the debate. It will begin with a brief consideration of the goals and key elements of the Green Revolution in agriculture and will then progress to a critique of its application in African contexts. It will conclude by attempting to tease out a few central factors which the author feels are vital reforms that must be implemented in African agriculture. Thus, the paper is grounded in recognition that certain reforms in African agriculture must occur (Matshe 485), but offers alternatives to the standard model for this Green Revolution.

The African Iteration of the Green Revolution

The Green Revolution was originally reliant on advances that had been made in agricultural technology around seed engineering, fertilizers

and pesticides, and it is this background which still permeates its current iteration. In many cases this involves both special high yielding seeds and a whole package of chemical inputs, which boost the nutrient content of the soil and suppress pests. Not only are many of these inputs damaging and disruptive to local ecologies, they are also a cost that farmers in many third world countries cannot absorb on their own. Technology such as hybrid seeds often have to be purchased every year, and restrictions from large multinationals often make seed-saving illegal. Additionally, there are the necessary inputs of fertilizer and other additives that must be purchased on a yearly or seasonal basis (Mosley 700). These are not simply start-up costs, but long-term considerations that must be factored into plans for subsidies and assistance packages. In some cases these concerns can be solved by government assistance or else the capital can be gathered by organizing farming communities in a collective fashion.

The application of Green Revolution thinking in Africa has met with mixed success. Alan Terry points to assessments which have argued that the varying climatic and soil conditions as well as the low degree of development of institutions within Africa has created an environment where the degree of adoption of Green Revolution policies has been broadly low (1). Scholars such as Paul Mosley have suggested that the differential success with which programs have met relies strongly on the sorts of policy choices made by governments. In particular, Mosley discusses the cases of Uganda and Ethiopia as being examples of situations where, for example, arms budgets were cut in favour of pro-poor policies, focused on subsidizing farmers' equipment or education and assisting in land purchasing (Mosley 713). In addition Mosley makes an important distinction between countries that have attempted to intensify agricultural practices (for example Uganda, Malawi, Kenya and northern Nigeria) and those that have tried to increase the amount of land in production (for example Ethiopia, Zambia and Lesotho), a process he labels "extensification" (Mosley 710). Of particular interest is the case of Uganda, where attempts were made at land use intensification coupled with pro-poor government policy that focused on education, healthcare, farming support and rural infrastructure (Mosley 713). Organizations such as the World Food Programme (WFP) have been very successful in progressing schemes in countries such as Malawi, which act to boost local smallholders by purchasing surplus crops, and feeding capital into local economies (World Food Programme). This approach allows organizations to target specific groups, such as women, by choosing which cooperatives or areas they purchase from (World Food Programme).

The Nature of Seed

Seeds are a central part of the technology espoused by many of the organizations, major philanthropists, aid groups, governments and NGOs pushing for an African Green Revolution. Major agricultural multinational corporations such as Monsanto breed special High Yield Varieties of seed (HYV seeds), often designed to produce larger or more uniform fruit. However they pose a rather unique set of challenges in an African context. Land-race seeds are varieties of seeds that have been gradually bred and adapted for the highly specialized local conditions, often for growth regimes that demand drought or pest resistance. Due to their diverse genetic background, land-race seeds are generally more robust and can better withstand the local growing conditions as well as outbreaks of disease. HYV seeds are often hybrids, which means that it is only the first generation that will have the desired traits. Traditionally, this has meant that farmers using hybrid seed are forced to buy new seed every year, but for many farmers this process is prohibitively expensive. One project that has focused on the use of seeds that can be produced by farmers themselves is the New Rice for Africa project (NERICA). NERI-

CA seed was used in Uganda with varied success (Kijima, Otsuka and Sserunkuuma 78). The seed did not fare well in variable rainfall environments, and suffered from lack of exposure amongst farmers (Kijima, Otsuka and Sserunkuuma 78). This demonstrates why agricultural reform in Africa must have, at its heart, a local, genetically diverse complement of seeds which have been locally developed and are available, advertised and affordable for small-scale farmers, and which will not necessitate the inputs of fertilizers and irrigation that HYV varieties commonly do.

Land Rights, Tenure and Employment

The organization of land tenure is another important consideration for agricultural reform in Africa. Central questions revolve around what is the most efficient model for the production of food and the mobilization of capital and labour. While the original Green Revolution may have pushed many farmers towards collectivization in order to muster enough capital (for the seed and fertilizer inputs), current programs for agricultural development seem to be largely oriented towards smallholder farming. In addition to these concerns over the ownership of the land, soils in Africa are often so poor that great caution must be taken not fall into an exhaustive pattern of land use. Traditional farming patterns have often involved a bush-fallow or swidden system, which has allowed the land to regenerate naturally without the unsustainable inputs of fertilizers and organized irrigation (Stock 198). The scale and degree to which agricultural reform is influenced by farm size and farming style is also an important consideration. In small-scale intervention, it may be easier to disseminate information to farmers, so that change and progress become more visible to donors and NGOs. However, it is also often easier to make large capital investments by creating larger groupings of farmers and land. Adding to these problems is the relative infancy of many agricultural institutions for research and teaching, a problem which foreign expertise can certainly help (Ejeta 831). The central question in the debate around scale is the degree to which these styles of farming can address food security at the household or the aggregate level (Misselhorn 34).

The Place of Agriculture in Trade and Social Policy

For some, trade may be the answer. Tibaijuka discusses incorporating export crops into African agricultural policy, as a way for farmers to access other markets and governments to try and draw foreign investment into agricultural and other related sectors (170). However, entry into cash crops and niche markets such as fair trade pose unique opportunities and challenges to African governments and farmers alike in terms of the foreign economic pressures they introduce. At this point African markets are in many cases relatively closed. Due in part to the unequal nature of global trade balances and the inadequacies of many African tariff protections and agricultural industry subsidies, and also due to trade policies often advocated by major international financial institutions such as the World Bank which often favour the Global North, Africa has struggled with enabling positive Foreign Direct Investment (FDI) that encourages domestic growth (Tibaijuka 172) and pushes food prices up (Xiao, Headey and Johnson 539). For this reason, the Alliance for a Green Revolution in Africa (AGRA) has focused on the removal of intra-regional trade barriers as a key goal for an African Green Revolution (Alliance). By expanding access to more local markets and increasing the abilities of African farmers to trade more widely within the continent, AGRA and others hope to involve greater numbers of producers and consumers (AGRA). By encouraging intra-regional, as opposed to international trade, it is hoped that the two goals of mobilizing investment and consumers will be achieved while dealing with local entities and regional gov-

ernments that are on more equal footings (Xiao, Headey and Johnson 539).

Agricultural reforms and policies such as the Green Revolution that push for increased efficiency in production are important for increasing the amount of food available, however problems of hunger are more complex (Misselhorn 34). Interconnected concerns such as disease (in particular HIV/AIDS), conflict and rural to urban migration are central to the discussions of the challenges of hunger or poverty (Tibaijuka 170). Migration in Africa is often caused by conflict, particularly in certain parts of Sub-Saharan Africa where there are large numbers of people semi-constantly in motion as refugees or internally displaced people. Furthermore, rural to urban migration is also a major concern in the rapidly urbanizing continent. The depopulation of the countryside is of concern to cities as they struggle with their blooming populations, and to the countryside that faces the next generation of farmers drawn away by the hope of better prospects elsewhere, or forced out by worsening rainfall and soil conditions (Annez, Buckley, and Kalarickal 228). This process will only be exacerbated by changes in climate and rainfall in the future (Annez, Buckley, and Kalarickal 228).

The Green Revolution and Aid Dependence

The Green Revolution is not only being endorsed by governments, but also by major donor organizations and philanthropists (Sanchez, Denning and Nziguheba 37). This model of philanthropy is often referred to as 'philanthropy 3.0' as it represents the latest iteration of the model of charity funding (Barrali). This model focuses on adaptive philanthropy, with emphasis on greater research, with money often being invested abroad in development schemes that target local people directly through smaller organizations. Support for philanthropy 3.0 is split in between the huge organizations and trust funds controlled by wealthy donors and the small scale micro-initiatives that rely on social media to boost awareness (Saunders). Leverage of both donors and governments is key, as charities and fundraisers struggle with donor-fatigue, so they are increasingly aiming to accomplish more with less (Barrali). This model is commendable, but also problematic since regardless of intent, it continues a colonial era flow of resources and expertise from the first world to the third. In many cases this 'third sector' (the NGO's and aid organizations) is often called upon to act as a temporary solution when governments find themselves unable to provide key services, which only acts to increase dependence on foreign aid (Saunders). While funds from philanthropists and other donors are vital to many projects, there is a need for appropriate avenues for donation, so that donors do not feel that they must act outside of governments, but rather that they are able to pursue social entrepreneurship or other schemes and contribute to development through government programs. This acts to allow a degree of domestic control, and also creates a platform for greater transparency and accountability. AGRA is one of the most prominent organizations in this field, and is uniquely placed to fulfill a similar function. AGRA focuses its resources on smallholder farmers with the stated aims of improving food security, increasing the family incomes of farmers, and achieving a sustainable agricultural revolution in Africa which will both support and protect farmers in the face of climate change (Alliance). The role of philanthropy must be carefully considered in the context of agricultural reform, in particular by the African governments who are the recipients of aid.

Changing Climates and Ecologies: Paths Towards Sustainable Agriculture

Finally, African agriculture needs to adopt a new perspective on sustainability. While the al-

leviation of poverty must remain a priority, governments must make sure that ecological concerns and changes are accounted for in policy and legislation around agri-development. Climate change promises to have tremendous impacts across Africa in terms of future rainfalls (Annez, Buckley and Kalarickal 228) and changes in temperature. While some Sahel regions of sub-Saharan Africa will be increasingly drought prone, other localities in the Great Lakes region of Africa will find that monsoon rains are worse than in the past, potentially leading to flooding, soil erosion and salinity problems. Sustainability needs to be approached on both environmental and economic levels, and definitions in policy rewritten to reflect a concern for both livelihoods and agricultural practices that do not contribute to the degradation of the land (Matshe 486).

Conclusion

Agriculture has a long tradition in Africa, which must be carefully considered. The imposition of strategies and technologies from outside must take careful notice of the practices of local indigenous agriculturalists. Authors such as Vandana Shiva have long cautioned that local knowledge and indigenous techniques and approaches are just as valid and important and must be considered on an equal footing with western techno-science. African indigenous agriculture represents a unique knowledge set, acquired over long periods of time, which is specially designed to encompass the local conditions (whether drought or high rainfall), and which represents a connection to local soils and seeds (Stock 195). Recognizing this body of knowledge as uniquely local and indigenous, not simply traditional, without the negative connotations of archaic and inefficient practice is a vitally important first step.

Agricultural reform should encompass both government subsidization and pro-poor spending regimes (Sanchez, Denning and Nziguheba 43). It also needs to look beyond simply being a solution to hunger by creating more food. Undoubtedly more food must be created on less land in order to solve the hunger problem in Africa, however, access to and the distribution of food are also logistical questions that must be addressed through greater government spending on trade and transport (Misselhorn 37; Matshe 486). Additionally, agricultural reform must be considered as part of a wider government strategy around issues of conflict, mobility and demographic change. Questions of conflict are certainly challenging to solve through agricultural policy, but policies could be put in place to help with the provision of employment and food for refugees and displaced people. In a similar vein, Africa's young people, as another mobile population, could also be targeted by policy driven by agricultural reform to offer them education, land and farming support in their rural villages. Additionally, there remains the problem of feeding huge urban populations in African cities. This demands new approaches to zoning and agricultural production in the city's environs, as well as an accompanying focus on transportation and logistical links from rural to urban centres and marketplaces. There is a need to find a middle path, which addresses the lessons of the Green Revolution, but incorporates more of the indigenous knowledge and technology of the region. It will be necessary to incorporate all of these elements in order to develop practical, workable solutions to the problem of hunger.

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WHAT'S IN A WORD: CONTEXTUALIZING NARRATIVES OF ENVIRONMENTAL DEGRADATION

Jeremy Elder

Abstract: *International discourses that inform environmental management policies rely too heavily on universalized narratives of environmental degradation. These narratives often situate subsistence communities and their livelihood practices as causal agents in scenarios of environmental degradation. Because they lack context, these narratives are fla ed; they are built upon socially constructed ideas of nature and degradation that originate from a Western understanding of "good" and "bad" nature. These narratives are also dangerous, because as normative agents they facilitate, justify and moralize top-down, interventionary environmental management practices that often exclude local stakeholders from both the physical lands they rely on, as well as from the process of deciding how these lands will be managed. In some contexts, these conventional narratives of environmental degradation are applicable, but in others they reproduce colonial patterns of land appropriation, justified by the superiority of western knowledge. For environmental management policies and practices to be truly sustainable, they must also be equitable and privilege local understandings of nature and degradation.*

Introduction

The health of the environment and welfare of subsistence communities often intersect in discourses of international development and resource management. Subsistence communities rely heavily on local ecosystems for their livelihoods, and it is widely accepted that degradation of these environments can further marginalize these communities (Robbins 76-77). In turn, the additional socio-economic marginalization these communities experience often forces them to exploit their environments even more, which increases the rate of degradation and results in a self-perpetuating cycle of increasing poverty and degradation (Robbins 77). This relationship is the reason that these two features – the health of the environment and welfare of marginalized people – so often collide in international discourse. Policy that informs sustainable environmental management must consider the reliance of marginalized people on their environments, while development aid aimed at addressing poverty and improving socio-economic wellbeing must consider the health of the environment.

Although this relationship appears simple, its practical application is anything but. Institutions like the World Bank, environmental NGOs, and various branches of the United Nations, as well as governments are concerned with environmental issues, and are aware of their complexities, but their management strategies are often founded on flawed narratives. For the purposes of this paper,

narratives can be understood as "stories of apparently incontrovertible logic, which provide scripts and justifications for development action" (Fairhead and Leach 1023). These narratives often limit the ability of organizations to address specific environmental issues because they decontextualize our understanding of human-environment relations. This paper seeks to explore these conventional narratives through the lens of political ecology and to introduce counter narratives that complicate, and sometimes contradict, universalized understandings of the relationship between environmental degradation and marginalized communities. Ultimately, the purpose of such an exploration is to emphasize that context and local knowledge are crucial for developing understandings of human-environment relations, especially when such understandings inform policies for effective sustainable development and environmental management.

Conventional Environmental Discourse

Three themes pervade international narratives of environmental degradation: environmental degradation is increasing through direct and indirect human impacts; the costs of this degradation are borne primarily by poor, subsistence communities; and intervention is necessary in order to prevent further, irreversible changes, and to improve the resiliency and welfare of the world's poor communities. The pervasiveness of these themes becomes apparent when examining the language employed by international development and environmental protection organizations.

The United Nations Environmental Programme (UNEP), for example, lists unsustainable resource use and ecosystem degradation from human impacts, such as agriculture, as primary causes of biodiversity loss (UNEP). Similarly, the World Wildlife Fund (WWF) lists agricultural practices among the five most environmentally damaging human activities. In fact, they claim that agriculture is the "largest driver of habitat and biodiversity loss [in] the world" ("Agriculture"). These impacts are driven by an increasing demand for agricultural products, which in turn has increased the scale and rate of land clearing. According to the WWF, lands converted to agriculture are stripped of natural vegetation, which exposes their soils to the erosive forces of rain and wind, and divests them of their fertility ("Agriculture"). These landscapes become degraded and unproductive with continued use, and are eventually abandoned to become part of the 12 million hectares of farmland lost to desertification every year (WWF, "Agriculture").

This discourse – "a specific set of representations and practices" that naturalizes and universalizes a particular "view of the world" ("Discourse" 166-167) – is echoed in the Millennium Ecosystem Assessment, which claims that human induced ecosystem change has been greater in the past 50 years than at any other time in human history (World Resources Institute 1-3). Driving these changes are swiftly increasing demands for "food, fresh water, timber, fiber, and fuel" (1-3). According to the World Resources Institute (WRI), the effects of environmental degradation are primarily endured by the poor, and in many cases are the "principle factor causing poverty and social conflict" (1-3). Of particular concern are dryland ecosystems, which have relatively low rates of precipitation and high rates of evaporation. These landscapes encompass 41 percent of the Earth's land surface, and are home to about one third of the human population (13). They are also representative of so-called "marginal" ecosystems, with low productivity and low resiliency to disturbance (13). These areas are also home to some of the poorest and most vulnerable (to the effects of environmental degradation) people on Earth (13).

These discourses of environmental manage-

ment often rely on conventional narratives that typically attribute environmental degradation to human "ignorance, selfishness, and overpopulation" (Robbins 90), and suggest that the "conversion of natural habitats into agricultural… landscapes" virtually assures an eventual transition into degraded land (Dobson, Bradshaw and Baker 515). The Food and Agriculture Organization of the United Nations (FAO) recognizes how urgently effective conservation and sustainability strategies are needed to restructure and improve agricultural practices and socio-economic conditions in marginalized communities (FAO, "Biodiversity"). Like the FAO, the United Nations Development Programme (UNDP) has a mandate to provide resources to facilitate capacity building in developing countries (UNDP). These resources can be knowledge-based, to inform improved environmental policies and national rural development strategies, and can also help to secure funding for related projects (FAO, "About the FAO"; UNDP).

The discourse employed by these organizations is founded upon a particular understanding of environmental degradation and human-environmental relations. In doing so, it has created a justification and a moral imperative for addressing environmental degradation and the welfare of marginalized peoples from the top down, as if these peoples were both responsible for, and incapable of, addressing the issue themselves. There is nothing inherently wrong with seeking to protect the environment and improve the lives of marginalized people. Scientific understandings of ecology and environmental processes are developed enough that we should take their claims of degradation very seriously. However, any broadly universal understanding will always represent a simplification of reality. This becomes problematic when decisions informed by abstract and decontextualized narratives are deployed into a variable and highly contextualized world.

What's in a Word? - Defining "Marginal" and "Degradation"

In Political Ecology: A Critical Introduction, Paul Robbins describes the conventional understandings of the terms "marginal" and "degraded" in the context of environmental assessment. Marginal environments are understood as those having limited productivity, heightened sensitivity to perturbation, and little resiliency (76-77). People that occupy marginal lands are in turn generally categorized as politically and socio-economically marginal, since it is presumed they would inhabit less marginal lands had they the choice (77).

A "degraded" environment describes an end state, the result of losses in ecosystem productivity that lead to an "injured" landscape. The causes of degradation are generally attributed to human impacts, for example through agriculture and land-use change, though natural variability is a compounding factor (91-97). Describing what productivity is "lost" is slightly more complicated. Robbins describes productivity-loss according to four categories: loss in natural productivity, understood as a decrease in "soil nutrients, increasing levels of [soil] salinity, and loss of surface biomass" (92); loss of biodiversity, referring to a decrease in the structure and diversity of an ecosystem's species matrix; usefulness, a normative measure, as it relies on subjective appraisals of what is considered useful, with the "what" ranging from financial returns on crop yields, to collective community benefits; and shifting risk ecology, which looks at whether environmental changes have put the ecosystem or local communities at greater risk of disturbance and disaster. Measures of usefulness are often captured in historical records, such as accounts of annual crop yields, and the prevalence of these records may be why its use as a measure of environmental change is so pervasive in formal management policy (94-96). Other definitions of degradation read essentially the same. For instance, the Millennium Ecosystem Assessment

Report defines degradation as a decrease in ecosystem services, which can be broadly defined as losses in natural productivity (WRI).

What's in a Word II - (Re)defining "Marginal" and "Degradation"

"It has been said that there are three versions of every story, your version, my version, and the truth" (Barry 42). "Wherever we look" says Peter Barry, "we see language constituting the world… not just reflecting it" (42). These phrases hint at a more complex understanding of words and language, and stem from three proposals made by Swiss linguist Ferdinand de Saussure (1857-1913): First, the meaning of a word is an arbitrary, social construction, and depends on convention for its maintenance. Second, these meanings are relational, and are defined by the suite of related words within which they exist. Third, the words, language, and meanings they convey do not reflect reality, they create it (Barry 40-43). With this in mind I want to explore and unpack the words "marginal" and "degraded," whose meanings are rarely questioned in conventional environmental discourse. By using this more critical perspective, we can begin to treat these words as representations of very specific ideas, rather than as descriptors of reality. To do so, we must begin by interrogating their definitions.

The Oxford English Dictionary defines marginal lands as "barely worth developing", and possessing a condition which approaches a limit "beyond which something ceases to be possible or desirable". These definitions incite questions: for what and for whom are marginal lands barely worth developing? What ceases to be possible and for whom is this activity desirable? Naturally, the answers to these questions depend on whom you are speaking with. An interrogation of the term "degradation" offers similar insights. Particularly interesting is the previously mentioned quality of "usefulness" as a measure of degradation. As Robbins notes, what is deemed "useful" is both subjective and normative (94-96). Similar patterns emerge when questioning definitions of "natural productivity". A loss of surface biomass is a common measure of degradation, but may favour species with greater biomass, such as trees, over those with less, such as grasses. Decreases in soil nutrients, another important measure of degradation, also biases against particular species, as some favour nutrient-rich soils, while others favour nutrient-poor ones.

The object of these analyses is to emphasize that conventional notions of what constitutes a "marginal" or "degraded" environment are constructed from a conceptual position located within the western imagination that ranks states of nature in very specific ways. Ask someone from the global north how they imagine a "marginal" landscape and the people that live there, and they will probably describe something akin to a desert: a brown wasteland inhabited by poor (brown) people. But other cultures with other understandings exist, and these do not necessarily conceptualize nature in the same fashion. Interrogating the meanings of words like "marginal" and "degraded" and unpacking the assumptions underlying their conventional imaginings draws into question their use as justification for top-down environmental management policies that fail to consider other, local environmental imaginings.

Critical analyses that deconstruct conventional narratives to unravel their origins and the assumptions underlying them can be a fascinating platform from which to begin constructing counter narratives. The following case studies provide insight into the influence and effects of global power networks on local livelihoods. However, as important as it is to consider these counter perspectives, we must avoid adopting a blanket-cynicism towards conventional environmental narratives, as we risk discarding well-intentioned and often well-informed efforts to address issues of real con-

cern, such as species extinction and poverty. Critical understandings should inform and question conventional narratives, but not dismiss them. In the case studies that follow, I aim to destabilize both conventional and counter narratives of degradation by illustrating contexts in which top-down intervention strategies informed by conventional narratives have improved environmental conditions and local livelihoods, and instances in which such approaches have led to the expropriation of land from the local community, resulting in disruption of local livelihoods.

Case Study I: China's Loess Plateau

The following case study is one instance where a top-down environmental management program informed by conventional narratives of degradation successfully improved environmental conditions and the lives of local communities. The Loess Plateau is a 620,000 km2 region in the northwestern region of China, and is home to over 100 million people (World Bank, "Restoring China's Loess Plateau."). This region is regarded as the "cradle of Chinese civilization", and has been actively cultivated for over 6000 years (ERSEC 9; Wang et al. 676). It is named for the large depositions of loess soil that were deposited between 2.4 and 1.7 million years ago (ERSEC 4). The region is characterized by cold, dry winters, and hot, humid summers. Rainfall, when it occurs, is often heavy (ERSEC 9).

Historical analyses suggest the plateau was once covered by forest, but hundreds of years of cumulative human impacts: unsustainable agriculture, deforestation, and overgrazing; have significantly changed the landscape (ERSEC 286). When the People's Republic of China was formed in 1949, just 6.1 percent of the entire plateau remained vegetated (ERSEC 169). Today the Loess Plateau is the site of one of the most extreme cases of soil erosion on Earth, losing approximately 3720 t/km2 of soil annually. (ERSEC 5; 50). By conventional understandings, the Loess Plateau is extremely degraded, and this degradation has been linked to the effects that local practices of slope farming, deforestation and overgrazing have wrought on the landscape (World Bank, "Restoring China's Loess Plateau").

Extreme levels of soil erosion impact local environments and communities in several ways. Agricultural productivity is adversely affected when soil organic matter and nutrients are lost through erosion (ERSEC 126). The deposition of sediment in waterways increases the frequency and severity of flooding (ERSEC 126). With no vegetation to protect the soil and retain water, droughts and dust storms have become more common (Wang et al. 675). The effects of these impacts on the Loess Plateau are felt further away as well. The Yellow River, which drains the Plateau, carries much of the sediment with it, depositing it downstream and increasing the risk of flooding in these communities (ERSEC 126).

But parts of the Loess Plateau have also been the site of some remarkable changes. In 1994, the World Bank partnered with the Chinese government to form the Loess Plateau Watershed Rehabilitation Project on 15,600 km2 of land (World Bank, "Loess Plateau Watershed"). The primary goal of this project was to increase agricultural production and farmer incomes, with a secondary goal of decreasing soil erosion and sedimentation in the Yellow River (World Bank, "Loess Plateau Watershed"). These objectives were approached in three ways. First, sustainable agricultural practices were introduced. These practices, based on terracing and the use of existing level farmland, replaced historically damaging slope-farming practices. Second, slopes were re-vegetated with trees, shrubs and grasses, to provide communities with fuel, timber, and animal fodder. In addition to this, grazing on sensitive sites was discouraged. Third, sediment retention dams were constructed to decrease the amount of sediment erosion

originating from slopes and gullies (World Bank, "Loess Plateau Watershed").

The results of this project were quite positive. The livelihoods of 2.5 million people were improved through the introduction of sustainable agricultural practices (World Bank, "Loess Plateau Watershed"). Natural resources were protected through changes in agricultural, grazing, and harvesting practices (World Bank, "Loess Plateau Watershed"). These, along with re-vegetation efforts, doubled vegetative land cover while waterway sedimentation was reduced by over 100 million tons per year due to re-vegetation and small dam networks. Furthermore, flood risk was reduced and water availability was increased (World Bank, "Restoring China's Loess Plateau."). Terraces improved crop production, and allowed for greater crop diversity, which led to increased employment rates and a doubling of farmers' incomes. Food security was improved through better water-use management and terracing practices that improved the productivity and reliability of farmlands. Terracing and sediment control also opened new areas to agricultural production (The World Bank, "Restoring China's Loess Plateau.").

The World Bank Project was a success by nearly every measure and has been replicated throughout China to the benefit of nearly 20 million people (World Bank, "Restoring China's Loess Plateau"). However, other analyses offer more critical perspectives. The belief that the Loess Plateau was historically blanketed in forest establishes an environmental "base-line", and the loss of this forest is claimed as evidence of degradation. However, one analysis questions whether the region was in fact "blanketed in forest", and thus calls into question how "degraded" the region actually was (Houyuan, Dongsheng and Zhengtang). Another questions the sustainability of afforestation, suggesting that the increased vegetative cover may actually reduce available soil water (Jiao et al.). Others voice concerns over impacts the project may have on the availability of water to those further down the Yellow River, a vast area of irrigated agricultural production that is already approaching the limits of available water supplies (McVicar et al.). Local voices of dissent are strangely absent, but this should not suggest that they do not exist, given the Chinese government's history of suppressing voices of criticism.

Case Study II: Counter Narratives

Unfortunately, less positive examples of external interventions, justified by universalized narratives of "degradation," are much easier to come by. If one general lesson can be extracted from the following examples, it is that the issues that arise in these cases are mostly the result of misunderstandings brought about by the application of decontextualized environmental narratives into context-specific local realities.

A classic example in which a conventional narrative of degradation diverges strongly from a local environmental history is found in the work of James Fairhead and Mellissa Leach, who during the 1990s described how narratives of forest degradation in Guinea were founded on conventional tropes that linked migration, overpopulation, and land-use change with environmental "degradation", and specifically with the loss of forest cover (Fairhead and Leach 1023). Their work centered around two locations: Kissidougou, a region in the south west of Guinea, and the Ziama forest reserve, located along the country's southern edge (1023). In both case studies a "degradation narrative" was constructed from a spectrum of assumptions and "false forest histories" (1023). These narratives incorrectly assumed an environmental baseline in which present day pockets of forest were presumed to be remnants of a historical forest that once blanketed the landscape (1032). Also written into this narrative was the assumption that the immigration of the savanna-dwelling Mandinka people, and displace-

ment of the "forest-dwelling" Kissi and Toma, had triggered environmental degradation through a combination of overpopulation and the introduction of unsustainable agricultural techniques (1023; 1032). The solution to this perceived degradation was forest conservation through the exclusion of local people, and the removal of local environmental controls (1032-1033). In reality, they argue, these narratives of "degradation" were patently false. Forest cover was actually increasing due to local livelihood practices, and the history of forest cover in the region was found to be more imaginary than real (1026-1029; 1030-1031). The overpopulation narrative was also found to be false, as the assumption of linear growth ignored historical fluctuations in population as a result of periods of abundance and periods of conflict (1030-1032). The top-down management policies put in place had only served to disrupt the livelihoods of people, and by restricting their ability to conduct the traditional livelihood practices that produced their environments in the first place, the top-down approach also reproduced old colonial tropes of western superiority.

In his work on Rajasthan, India, Paul Robbins describes two contrasting views of nature. The first, held by a state forester, is excited and proud of the growing success of a project to increase forest cover in this dryland ecosystem (107-108). His efforts, part of a government mandate to increase forest cover, are intended to reverse a long history of "abuse and neglect" (107-108). The second view is that of a local herdsman. His view of the landscape contrasts sharply with that of the forester. Rather than seeing a regenerating landscape, he views the afforestation as a "hazard and a blemish" that has introduced trees of "no value" (108). The trees, he argues, crowd out desirable grasses and livestock forage, and threaten his livelihood (108). In his view the spread of forest cover is not environmental restoration, it is not even a forest, it is "banjar, [a] degraded wasteland…an English landscape" (108). This example illustrates just how dramatically interpretations of the same environment can differ, and emphasizes the idea that "natural" categories are social constructions, rather than pre-existing states of nature. It also hints at the potential impact of top-down environmental management on local communities, as the future of the herdsman's lifestyle in the changing environment he calls home becomes unclear.

Conventional narratives that ascribe the cause of desertification to overgrazing and overexploitation through agriculture have similarly been questioned. Diana K. Davis artfully describes the French-Colonial origins of such narratives in North Africa ("Desert Wastes" 359-360). There, (mis)understandings of local environmental histories, born of French misinterpretations of Roman writings that described the region as the bread-basket of Rome, led French colonial officers to believe that the Maghreb had been degraded through pastoral practices from an imagined previously fertile and forested state ("Desert Wastes" 361-370). In fact, more recent historical environmental analyses suggest that the region was never completely forested, and was in fact well adapted to local pastoral practices ("Desert Wastes" 374). This narrative was used to justify expropriation of land, changes in land tenure, and the criminalization of traditional practices ("Desert Wastes" 374-379). I would argue that this imperialist trend of appropriating local control of environments is not simply a feature of the past, but rather, it persists to this day as a result of the flaws in contemporary environmental management policies that are built from decontextualized conventional degradation narratives. In a separate piece, Davis illustrates how these persistent narratives continue to justify arguments that blame pastoralists for "degradation", and further marginalize their ways of life ("Indigenous Knowledge" 509).

(Re)Contextualizing Narratives

The intention of this exploration was to un-

settle and complicate conventional and counter narratives that infuse international discourses of environmental management and sustainable development. The Loess Plateau Rehabilitation Project was chosen to emphasize that measurable improvements to ecosystems and local livelihoods can indeed be achieved through externally informed environmental management strategies. However, as the counter narrative case studies demonstrate, an awareness of the assumptions that constitute conventional environmental narratives must not be brushed aside. These examples suggest that a universalist model of environmental management is not only unrealistic, but also potentially harmful to local communities. Marginalized populations in "degraded" environments need access to international resources, but conventional management strategies and the national policies they affect must be informed by indigenous knowledge(s) if they are to be environmentally and socially sustainable.

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Urban Nature

STILL CREEK AS A WATER-DISPOSAL MACHINE: AN ARCHIVAL SURVEY 1913-1988

Kevin Chan

***Abstract**: Still Creek, located in Vancouver, British Columbia is one of only two creeks that still fl w partially above ground in the city. Although it is in some respects an unremarkable urban waterway, its progressive development into a storm water conveyance channel provides insight into Vancouver's changing relationship with water since the early twentieth century. I argue that the role of Still Creek as a major drainage trunk has largely been obscured by the "natural" system within which the drainage system has been incorporated. I seek to investigate the ways in which Still Creek has been incorporated into the district's drainage system through a particular (and intentional) combination of technological and natural systems and how it can be better understood as a "water-disposal machine." I consider both physical changes (such as the dredging, straightening, and culverting undertaken by the Greater Vancouver Sewerage and Drainage District to increase its maximum water carrying capacity), and changes in popular perception that occurred over the course of the twentieth century.*

Introduction

Still Creek is one of only two remaining creeks in Vancouver that still run partially above ground. However, the creek's official designation as "a major drainage facility" by the Greater Vancouver Sewage and Drainage District (GVSDD), is actually quite revealing (Engineering & Health Dept.), and serves to demonstrate that Still Creek is a 'creek' only in name. In fact, it serves the far more utilitarian function of draining most of East Vancouver and Central Burnaby. Historically, the creek has always drained large areas of what was to become East Vancouver, but as the area was developed and paved the intensity of run-off that the stream had to accommodate increased. Over its history, the GVSDD has spent millions of dollars on channel improvements including dredging, straightening, and culverting to "improve the water carrying capacity of the system and reduce the risk of flooding" (Engineering & Health Dept.), leading some to argue that nature has been transformed to meet human needs (Stuart 418).

This is not to suggest that human action is always in conflict with nature, a position that Martin Melosi finds to be "static and unappealing" (Melosi 7). Likewise, William Cronon argues that "pristine wilderness" is largely a dangerous myth (qtd. in Talon and Brody 685). While numerous scholars have recognized that there is a common narrative suggesting that cities are human constructs and therefore destroyers of "nature" (Melosi 6; Talon and Brody 684; Clement 302), I am more interested in the ways that (human) technology and natural systems co-exist in the urban landscape, and in particular, the ways in which the former have been incorporated into the latter.

A perspective provided by Nicole Stuart sug-

gests, "our technologies have been used to transform nature into a range of products required to sustain our civilizations" (418). She believes that technological networks are the "mediations" through which a perpetual transformation of the city takes place. In fact, Stuart argues that industrial technology itself emerged alongside a new epistemology that human societies are distinct from their natural environments (418).

In Urban Waste Sinks as a Natural Resource, Arn Keeling suggests that, "Emphasis on the politics and . . . technologies of sewage treatment obscures the ways in which nature has been incorporated into technological waste-disposal strategies" (58). This is partly because natural systems are seen as existing outside urban networks rather than as part of them. Sewage planning blurs the boundaries between human "technological systems" and non-human "biophysical phenomenon" (58), as existing waterways are included in larger disposal networks. While Keeling focuses on raw sewage disposal, I try to make similar arguments about surface water removal, which, at least in Vancouver, has been incorporated into the larger network of streams and rivers. In contrast to Keeling I argue that the role of Still Creek as a major drainage trunk has been obscured by the "natural" system within which the urban water disposal system has been incorporated.

While we are accustomed to thinking of Still Creek as a natural system due to its origins and current free-flowing sections, the creek would be better understood as a "water-disposal machine," which has arisen over time due to a particular (and intentional) combination of technological and natural systems: a conglomeration "having several parts, each with a definite function which when put together perform a particular task" (OED, "Machine"). Considering Still Creek's role in water management in Vancouver — and the various systems that have been built and connected to the creek to allow it to perform this function — it is not hard to think of the creek in mechanical terms. Drawing upon archival sources from 1913 to 1988, this paper will present a historical survey of Still Creek's development into a "water-disposal machine," hidden within the stream that it has been built inside.

Geography of Still Creek

Still Creek is part of the Still Creek-Burnaby Lake-Brunette River watershed, which passes through several municipalities including: Vancouver, Burnaby, Port Moody, Coquitlam and New Westminster (GVRD 28; Hudema Consulting 7). The headwaters of the creek lie in Burnaby, near the Metrotown area from where it flows west in a culvert, and enters Vancouver slightly north of Kingsway at Boundary Road. (Engineering & Health Dept.; Hudema Consulting 7). Eventually, Still Creek feeds into the Brunette River via Burnaby Lake, which drains into the Fraser River, the province's most important salmon supporting river (Hudema Consulting 23).

The Lea Report and Drainage as Natural

In 1911, a report was commissioned by the Vancouver and Districts Joint Sewerage and Drainage Board. It was completed by R.S. Lea in 1913 and was responsible for laying the groundwork for the future of Vancouver's sewage and drainage system. Several of Lea's recommendations had particularly important implications for Still Creek and its future role in storm water drainage. Lea was in favour of a separated system where waste was kept entirely apart from the surface water flow, with different channels being provided for each (Lea). He noted that from an engineering point of view, dealing with sewage and drainage are actually two distinct problems. Sewage, which he defined as the collection and disposal of the domestic and trade refuse of the community, has a relatively small volume and constant flow but is highly polluted. On the other hand, Lea argued that surface

water, the rainfall that runs off paved and impervious surfaces, has a considerably higher peak volume, but only flows occasionally and is relatively "innocuous," at least compared to sewage. Thus surface water could be discharged into channels like False Creek, English Bay, and Burnaby Lake where crude sewage would be objectionable (Lea). Separated systems are more expensive (and often considered a luxury), but as Lea himself noted, "the luxury of to-day becomes the necessity of to-morrow" (Lea 23). In fact, in Lea's mind, the surface water system need not cost more money at all. This is because the surface water system does not need to travel as far as the sewer system since it can be routed directly into local bodies of water, while the sewer system needs to travel longer distances for treatment.

Figure 1. "Sewer Construction at China Creek 1913" (City of Vancouver Archives, 1913, Str P270.05).

As early as Lea, technological and engineering solutions to storm water management have obscured the ways in which the very streams themselves have been incorporated into the separated sewer system. When speaking of storm water management, for example, emphasis is placed on the system, the necessity, the engineering, and the economic viability: but the significance of harnessing the stream itself is never addressed. As Keeling notes, this "encourages rational exploitation of receiving waters as part of disposal structures" (58). For his part, Lea was aware that he was intending to utilize streams and in fact considered the process to be a continuation of nature's original purpose. The following quote from his report is particularly revealing:

Of course, as a district develops, land becomes valuable and the creeks have to be culverted and filled in. But, provided the culverts are properly designed, there is no reason why these creeks should not continue to carry out the functions that nature constructed them for, that is, the removal of surface water from their natural drainage area (22; emphasis added).

Perhaps surprisingly, this logic seems to break down the traditional urban-nature dichotomy that pervades contemporary thinking (Melosi 6) in which, "nature is really only nature when it is completely separate from ourselves" (Talon and Brody 685). Rather than thinking about nature as unconnected, Lea encourages the expropriation and "inclusion" of nature for the purposes of urbanization, in purely rational terms. Thinking about nature in utilitarian terms, where nature's purpose is to be used by humans makes sense when nature itself is seen as a resource (Keeling 59). Lea's report became the foundation of drainage planning for decades to come and set the stage for a massive culverting program along Still Creek and across Vancouver.

The Next Twenty Years

The Lea plan was quickly implemented and the first "improvements" were made to the Still Creek system in 1914 (Rawn et al. 203). However, while some systems such as China Creek were subject to intensive culverting efforts (Figure 1) there exists

little record of changes to Still Creek during the 1910s. Presumably this is because development was halted by the onset of the First World War.

In 1922 the first major project to alter the Still Creek-Burnaby Lake system was proposed. The plan involved lowering the lake level by several feet and would have seen the creation of 2000 acres of agricultural land on the north end of Burnaby Lake ("Lake Lowering," 14). The lake was "re-engineered" for a new purpose in an urbanizing region, which was expected to grow to 200,000 people by 1950 (Lea). The idea that such engineering was unproblematic hinged on Lea's argument that streams — and by extension all of "nature" — exist for use and expropriation by humans.

The Great Depression and The Age of Relief Work

If the 1920s saw relatively modest changes made to Still Creek, the 1930s represented a period of major transformation. Work in the Still Creek drainage area was conducted as part of a relief project intended to employ jobless labourers registered on the city's relief lists (VDJSB). During this time period, the VDJSB straightened, widened, and deepened Still Creek along its current channel from Rupert Street to Boundary Road, widening the creek to 15 feet at its bottom and 30 feet at its top (Howlet). Late in 1935, the project was extended for an additional two months with an expanded workforce of 1200 labourers ("1200 Still Working"). A full year later in 1936, drainage work on Still Creek was still ongoing and had been able to secure a further $10,000 loan from the Federal Finance Minister ("700 to Keep Jobs" 1).

The project to deepen Still Creek required the level of Burnaby Lake to be temporarily lowered so that men and heavy equipment could work in the creek channel (Cleveland). The lake lowering provoked some anger from local residents who were upset that work was "spoiling the beauty of the lake" (Snowball). This should remind us that for many citizens the aesthetic nature of Still Creek-Burnaby Lake are far more important than the utilitarian/technical functions of the creek which are either hidden behind the aesthetic beauty or considered to be of less importance than the system's natural landscape.

The Post War Period and Ultimate Drainage Capacity

After the Second World War, the Lower Mainland experienced rapid development and growth. Combined with the removal of forested areas, contemporary engineers argued that the emerging landscape was already enough to "render the capacity of certain natural drainage corridors completely inadequate," (Rawn et al. 199). Urbanization was taking its toll on stream corridors, which were not suited for the increasingly intense runoff ("Gov't Orders Flood Survey" 1). It became necessary to update Lea's plan.

The new drainage plan was officially released in the 1953 report entitled Sewerage and Drainage of the Greater Vancouver Area but colloquially became known as the "Rawn Plan" named after its lead author. Rawn was sure to specify that, "In planning for the disposal of storm water from the Greater Vancouver Area, the existing drainage facilities must form the basis of any comprehensive master plan of drainage" (Rawn 200; emphasis added). Of course the existing drainage facilities mentioned here was the network of streams and rivers.

While Lea thought of streams in terms of natural functions, Rawn believed that science was able to subdue and control nature for the benefit of humans and urban expansion. In his words, natural watercourses exist to be "improved," and "reconstructed." While the result of both plans

was essentially the same, Rawn's ideology differs in that it removed any notion of the natural. For some, like Stuart, engineering represents a dream in which human feats subdue nature, control the 'environment', and manipulate natural 'resources' to human ends (419). Rawn's plan sought to create a truly efficient system to take advantage of technology and engineering.

In the long term, the new plan called for the last remaining open sections of Still Creek to be fully enclosed within culverts from Renfrew Street through to the upper end of Burnaby Lake. It resulted in several localized culverting projects including a bridge in Burnaby that was replaced with a culvert and road in 1953 in addition to other projects ("Culverts,").

In 1959, a major trunk sewer was built in Collingwood ("$180,000 Jobs" 27). The trunk sewer emptied into Still Creek, making use of the developed waterway. The Collingwood Trunk sewer extends the reach of the "disposal machine" by connecting a new apparatus (the Collingwood area and its underground drainage infrastructure) to the main body of the Still Creek drainage system.

The Sixties and A Community that Cares

The 1960s represented the emergence of a desire for the creek to be seen as more than just a drainage system. The waterway was presented as both a natural place and a jewel in the city when the Lower Mainland Fish and Wildlife Federation was interviewed for the Vancouver Sun about an oil spill which threatened the local bird population ("Who Will Pay Bill" 2). The designation of Still Creek became unclear as groups other than the drainage authority (the GVSDD), attempted to redefine the creek in natural terms rather than simply as a water conveyance channel. Whether these attempts legitimately challenge Still Creek's role as an integrated drainage system, or simply work to further obscure the system's natural-technological integration is not completely clear.

The Seventies and Dire Warnings

On May 21st 1970, an important meeting between Vancouver's Engineering, Permits & Licenses, and Health Departments took place due to concerns about high levels of contamination in Still Creek. The main pollutants included faecal matter and oil wastes, and there was even "visual faecal contamination" in some areas ("Information Release"). The mean faecal coliform count was nearly 100 times the standard used for recreational areas (Engineering & Health Dept.). In response the Medical Health Officer decided to post signs along the creeks entire length, essentially closing the creek to the public. (Bonham; "Information Release"; "Warnings Posted" 77; Figure 2) The restrictions were meant to be temporary, but similar signs still remain today.

Figure 2. "Warning signs still posted over 40 years later" (Chan, 2011).

A concerted effort was made to locate cross-connections where houses had illegally hooked their sewage pipes to the storm sewer (Engineering & Health Dept.). While these efforts did reduce faecal coliform levels to some extent, it was ultimately unsuccessful. In part, this was due to

the difficulty of locating and fixing faulty sewer connections but was also due to the fact that pollution in urban-industrial regions does not only come from single point-sources but from all over the urban landscape, as reported by the Westwater Research Center of UBC (Engineering & Health Dept.). Urbanization itself causes pollution that cannot be traced to a single source, but links the fate of the creek and its surroundings together.

The Eighties and Development as a Tool for Rehabilitation?

In the eighties, creek rhetoric took a new turn. The 1985 Vancouver City Council joined Burnaby by adopting Policy 6.5 to "maintain the open state of the Still Creek watercourse and enhance the appearance and accessibility of some portions" (Mellander). Furthermore, in 1986 the council resolved to encourage private landowners to submit applications for rezoning in exchange for a covenant requiring Still Creek to be retained as an open watercourse with public access or in some cases to daylight selected culverted sections (Mellander). The first successful application under this policy was by the Real Canadian Superstore in 1988. An 8,546 square meter retail store with additional office and industrial space was approved on the condition that the waterway remain open and that $1.25 million be spent creating public walkways along the creek and stocking the creek with salmon ("Council Approves Rezoning").

The new age of development and rehabilitation of the creek raises interesting questions. The amount of engineering in the creek has not necessarily been reduced but has changed focus. Instead of building culverts solely for efficient water removal, an emphasis was placed on engineering ecological sites to reduce pollution and provide recreational areas, such as new public walkways (Board of Parks and Recreation). The ways in which Still Creek has been incorporated into the storm water management system is still largely veiled, perhaps even more so, as its recreational and "ecological" values become more important. Nevertheless the new era of Still Creek is no more natural than its culverted predecessor, largely because thinking about Still Creek as a natural system, as opposed to a technological one is highly problematic. Despite changes in outward appearances, the creek remains an important storm water conveyance channel for a large part of the region, ceasing to be simply a creek many years ago.

Conclusion

To argue that the process of daylighting and rehabilitation of the creek actively obscures its natural-technological relationship is not the same as to argue that daylighting is bad. In an ecological sense the process may even be helpful (Monde and Siegfried 54), and yet a more aesthetically pleasing creek does not change the ways in which it can be thought of as part of the "water-disposal machine." The City of Vancouver's website seems to recognize that the creek's surrounding environment has fundamentally changed through the process of urbanization and that the creek will never be as it once was ("Revitalizing the Creek").

While respectful of the great changes Vancouver has brought to the landscape, what fails to be acknowledged is the creek's role in surface water drainage and the ways that the creek itself has been manipulated over the past century. Urbanization did not just take place around the creek but also to the creek itself. What we think of as a "creek" is really a highly integrated techno-natural machine. A series of very specific processes have been undertaken to transform the creek into an efficient storm water management system, which has effectively incorporated utilitarian-technological systems into "natural" ones. The creek and the storm sewer can only be understood together. They are a mutually sustaining, interrelated system and because of a very specific historical development one can no longer exist without the other.

Like in Sapporo, Japan, where some urban streams use pumped water or treated sewage to create flow (Asakaw et al. 178), Still Creek is now largely reliant on water from the storm sewer network to maintain its flow. Ironically, the same storm water causes unpredictable flow rates, makes the creek unsuitable for fish habitat, and causes flooding risks (Hudema Consulting 15).

From 1913 onwards, Still Creek has been subjected to an almost continuous process of culverting, channelization, and straightening undertaken to drain our city in what was thought to be the most efficient and economic way possible. However, the process has been a dynamic one and as I have tried to illustrate, changing technology and values have led to different patterns of development over space and time. Recognizing that Still Creek is embedded within a larger network of streams, rivers, pipes, and channels — interconnected both in function, and historical development — can provide an insight into the relationship between the stream, its technological appendages, and the city.

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AN EXPLORATION OF STREAM DAYLIGHTING AND URBAN ATTITUDES TOWARDS THE ENVIRONMENT

Caitlin Sinclair

Abstract: *Stream daylighting is the process by which a concealed stream is deliberately exposed to once again fl w on the Earth's surface (Pinkham "New Life for Buried Streams"; O'Neil and Buchli). Since the first daylighting project in Napa in the 1970s, stream daylighting has become an increasingly popular trend in urban centers in North America, Europe, and Asia. The discussion in this report focuses on stream daylighting as a means for understanding urban attitudes and values of nature—what can the recent desire among urban citizens to unearth hidden streams tell us about the urban relationship with nature? Using observations from various stream daylighting studies, this report identifies environmental and social advantages/ successes and disadvantages/shortcomings of stream daylighting. Th ough these findings, it is concluded that stream daylighting can be understood as a process that provides several social benefits, but fails to create a measurable urban conservation area. This analysis was then used in a discussion to critique urban attitudes and values towards nature. Ultimately, this report concludes that stream daylighting reflects both a 'human centric' and an altruistic attitude towards nature. Urban conservation projects must be understood as they influence both local and global environments and attitudes. It is further suggested that additional research concerning stream daylighting should incorporate an assessment of the economic advantages and disadvantages of stream daylighting.*

Introduction

When you look at a map of Vancouver's lower mainland some distinct features jump out. Some will notice the coastline that skirts around the city, while others will identify the point of "Stanley Park" or the University of British Columbia campus. Nature enthusiasts might notice the towering mountains holding the city captive, while consumerists zero in on the shopping districts. Although such features of a city are important to a discourse surrounding environment and society, this paper is not concerned with those urban features easily found on a map; rather, it is interested in those features which are hidden (both cartographically and physically), and the rate at which they are being uncovered. This paper is concerned with the urban phenomena of 'stream daylighting.'

On 10 September 2010, Steven Quinn's CBC radio show "On the Coast" endorsed the False Creek Watershed Society's September Salmon Celebration through an interview with society member Celia Brauer (Quinn). During this interview, Ms. Brauer took the opportunity to advertise the society's historical stream walks. The walks, open to the Vancouver public, were designed to inform Vancouver citizens of the numer-

ous streams concealed during the development of the city (ibid.). My interest and argument for this paper originates from Quinn's interview with Ms. Brauer and the recent desire amongst Vancouver citizens to acknowledge and unearth the once forgotten streams in the Greater Vancouver Regional District; why, after all the years of building, developing and urbanizing Vancouver's landscape, are residents now curious about what has been long covered and forgotten? What does this process tell us about the relationship between urban society and the environment? An answer to this query leads directly to the new urban design tool of stream daylighting.

Stream daylighting, the process by which a concealed stream is deliberately exposed to once again flow on the earth's surface (Pinkham, "New Life for Buried Streams" 1), is a relatively new concept in environmental urban design, and has recently gained the attention of government institutions, urban planners, and citizens alike. Streams are a useful means for addressing society's attitudes towards the environment, as they are places of both social and environmental significance. Therefore, the objectives of the following study on urban stream daylighting are twofold: firstly, to research, examine and assess the environmental and social impacts of stream daylighting in an urban setting; and secondly, to undertake a discussion surrounding society's attitudes towards the environment.

Methodology

The diverse literature surrounding stream daylighting is comprised of academic papers, individual studies, interviews, journal essays, and video documentaries. Although the major sources of information on stream daylighting continue to be government project reports, websites of urban conservation organizations, and newspaper articles, the following study has utilized peer-reviewed works from stream daylighting researchers whenever possible. The works of Richard Pinkham, commonly viewed as the leading author on stream daylighting, as well as Kit O'Neil and Peggy Gaynor and Conradin and Buchli provide the foundation of research for the paper. Additionally, of key importance to this study are the master's theses by Scott Jones and Matthew Fitzsimmons, researching stream daylighting as an environmental tool, and as stream daylighting as a means for 'rediscovering' nature, respectively.

To examine the social and environmental advantages and disadvantages stream daylighting, my research explores case studies of daylighted streams from several sources. This approach emulates that taken by Buchholz and Younos who, in light of the relative dearth of scholarly publications on the topic, used case study reviews to inform their evaluation of post-daylighting monitoring standards (Buchholz and Younos). Firstly, research was undertaken to compile a number of sources relating to stream daylighting. These sources were then investigated for claims of environmental and social successes and shortcomings. Where a source indicated that stream daylighting led to an environmental benefit, it was recorded in Table 1 under the heading "Environmental Advantage/ Success." Likewise, when a study indicated that stream daylighting led to an environmental hardship, it was recoded as an "Environmental Disadvantage/ Shortcoming." The same procedure was undertaken for social indicators. The findings of this research are summarized in Table 1(Appendix A). In the event that more than one source identified the same advantages or disadvantages, both authors were recorded in the table.

A concern of this study stems from the subjectivity in classifying environmental or social characteristics as 'advantageous' or 'disadvantageous'. A key example of this is the designation of 'attraction of homeless people' as a social disadvantage. Although presented in Pinkham's study as a disadvantage to communities ("New Life for Buried Streams" 8), creating a safe, comfortable

public space may be viewed as an advantage for the homeless people who may be otherwise faced with living on city streets.

A further limitation in assessing the advantages and disadvantages of stream daylighting stems from the difficulty in comparing stream systems due to their "several unique characteristics" and diverse physical compositions (Spellman and Drinan 5). Furthermore, variations in the size, geographic location, and financial constraints of each daylighting project are significant factors affecting their outcomes, and may affect the degree to which a given project achieves environmental and social success. These limitations risk painting an overgeneralized and oversimplified picture of stream daylighting trends, and consequently of urban attitudes towards the environment. Moreover, stream daylighting is a new trend in urban design, and in many cases it is too soon to comprehensively assess the environmental outcomes. Therefore, the purpose of this study is to consolidate various reports on stream daylighting to offer readers a broad understanding of the advantages and disadvantages of stream daylighting, and to assess the inferences that can be made regarding society's attitudes towards the environment.

The Urban Stream: A Flowing History

Modernity, and the rise of urbanization, brought with it the degradation and paving over of urban streams, illustrating urban attitudes of 'neglect' and 'disparagement' towards them. Modernity, "the application of scientific principles to human and natural worlds," (Booth et al. 1352) was a significant philosophy driving society's dedication to growth and development (Dictionary of Human Geography 471). Modernity also served as a driving force behind urbanization, and together these two forces adversely impacted the natural ecosystem of small streams in several cities (Paul and Meyer 603; Booth et al. 1353; Wolman and Chamberlin 216). Specifically, urbanization led to an increase in the use of streams as waste repositories, resulting in outbreaks of disease and illness (Jones 7). According to Kim Story and James Brown, the polluted streams changed the status of urban watersheds "from resource to health hazard" (16) as urban citizens no longer associated streams with recreational activities, but with sickness and disease.

Urbanization also resulted in increased paving of the urban landscape to accommodate the rise of the automobile (Register, "Balance of Nature" 241). Streams were a physical barrier to paving efforts in the 1900s, and so they were viewed as a hindrance to development (Brown and Storey 17). As a result, city engineers proposed the culverting of urban streams to allow for streets, roads, and highways to be constructed. Between the 1940s and 1950s thousands of kilometers of streams in America were damaged, disturbed, or destroyed by the processes of urbanization (Paul and Meyer 604). The loss of urban streams to the bourgeoning paving of Vancouver suggests that open urban streams were no longer valued for their aesthetic appeal in the urban setting (Figure 1).

For modern, urbanized societies the burial of streams "[reflects] an attitude that nature [is] to be found in the wilderness and open spaces," not in the city (Brown and Story 18). As Jessica Hall suggests, the historical process of culverting streams within the city is "a metaphor for the way we have 'buried' our connection with nature" (Hall qtd. in Buchholz and Younos).

Today, urban living has become the dominant lifestyle for the majority of the world's population (Tomalty 2), and by 2030 the world's global urban population will reach an estimated five billion people (Brown et al., "Effects of Urbanization" 2). If past trends are an indication of the future, urban streams will face increasing threats as urban development strives to accommodate rising urban

populations. More recently, however, nature has begun to be understood as an asset indispensable to the city, and streams have been revalued for their benefits to urban society through their ecosystem functions and social benefits (Meyer et al. 603). Perhaps this 're-appreciation' of ecological systems within urban settings indicates that urban attitudes towards streams and nature have changed yet again. But to what degree is this motivated by a concern for increasing social welfare, and to what degree is it a movement to create areas of environmental conservation in an urban setting? And, what can this tell us about urban attitudes towards nature? The following assessment of advantages and disadvantages of stream daylighting attempts to answer this query, and, in doing so, to shed light on the complexity of understanding society's attitudes and nature in the urban landscape.

Stream Daylighting: Environmental or Social Advantage?

Global Growth of Stream Daylighting

Stream daylighting, suggests Pinkham, has been undertaken in a variety of landscapes, both urban and rural, and on an assortment of streams, from small, temporary creeks to large rivers ("New Life for Buried Streams" 7). The process of daylighting a stream varies with the degree to which a given stream is "re-naturalized"; some daylighting projects focus on restoring a natural earthen bottom in the creek, others utilize manufactured materials such as granite, while others bring streams back to the surface through the use of concrete corridors (ibid. 8).

For many daylighting projects, urban conservation—improving habitats for wildlife species under threat – is an assumed outcome (Jones 17). As such, the primary motive for undertaking stream daylighting is often the restoration of disintegrated riparian habitat. Other motivations stem from the desire to use open stream channels for water runoff transportation (ibid.81-2), or to create spaces for urban recreation (Conradin and Buchli 275).

Since the first daylighting initiative in the 1970s in California, stream daylighting projects have been undertaken in several cities across the world. Although some have denied that the 1970s daylighting of Napa Creek was the "first daylighting project" since it did not "re-naturalize" the stream, uncovering Napa Creek represented a "new way of thinking" for urban engineers, planners, and politicians (Baume). The daylighting of Napa Creek marked an important shift in society's perception of the streams in California's Bay Area, and across the world. Today, the San Francisco Bay area boasts North America's highest concentration of daylighting activity, with over 20 stream daylighting projects (Pinkham, "New Life for Buried Streams" 2). Most noticeably, the area of Berkley has completed the daylighting of over 850 feet of streambeds across three tributaries (ibid. 3). In America, stream daylighting projects have been completed or are underway in twelve states (O'Neil and Gaynor; Pinkham, "New Life for Buried Streams"; "Opportunities in Pittsburgh"; Wild et al.). In Europe, Denmark has reported over 33 daylighting projects, and in England, the areas around Liverpool, London, Worchester and York have all undertaken stream daylighting initiatives (Pinkham, "New Life for Buried Streams" 10-16). Additionally, a portion of the Johannisbach River in Aachen, Germany was daylighted in 1999 (ibid.20) and a recently undertaken project in Zurich, Switzerland, will see 18 miles of streams daylighted (Conradin and Buchli, 276). In Seoul, the daylighting of the Cheonggyecheon River in 2003 recovered more than three miles of the river, restoring the watershed as the "centerpiece" of the city (Revkin, "Peeling Back Pavement").

Environmental Advantages/ Disadvantages

The environmental advantages of stream daylighting can be grouped into four categories: improved ecological habitat, increased biodiversity, improved water quality, and improved urban air quality (see Table 1). The restoration of ecological habitat, suggests Pinkham, is a fundamental environmental benefit of almost every stream daylighting project ("New Life for Buried Streams" iv). Increased local biodiversity through the restoration of ecological habitats is yet another positive aspect of stream daylighting. The improvement of stream water quality is a further advantage, and is often a primary objective of urban daylighting projects (ibid. iv-v). Finally, daylighted streams have been identified as valuable tools for bringing cool air into crowded downtown areas and improving air quality (ibid.v).

Although case studies indicate that stream daylighting is often successful in increasing biodiversity and improving ecological habitats, it remains questionable how successful projects have been in restoring habitat and creating areas for ecological conservation. In many cases, 'improvement' in ecological habitat is measured relative to the urban conditions extant immediately prior to daylighting, rather than to the original ecological state of the landscape. For example, in 2004 daylighting a portion of the Spanish Banks Creek in Vancouver had "successfully restored" a portion of the creek and "improved stream habitat" (Spanish Banks Creek Daylighting) since the project had resulted in the return of 60 Coho salmon to the creek (Raincoast Applied Ecology). However, Vancouver pioneer Harold Haywood remembers that in 1915 there were, "hundreds and hundreds and hundreds" of salmon spawning in Spanish Banks Creek (Harris 3). The failure to use historical ecological conditions as a baseline in studying the environment has been termed the "shifting baseline syndrome" by Dr. Daniel Pauly of the UBC Fisheries Centre (430). He argues that this provides an "inappropriate reference line for evaluating" environmental and economic gains and losses (Pauly 430). Thus, while most stream daylighting projects do increase biodiversity and ecological habitat availability, the degree to which a project can be deemed a 'successful environmental restoration' is questionable. Further studies on the effects of stream daylighting projects on the environment should incorporate historical baselines.

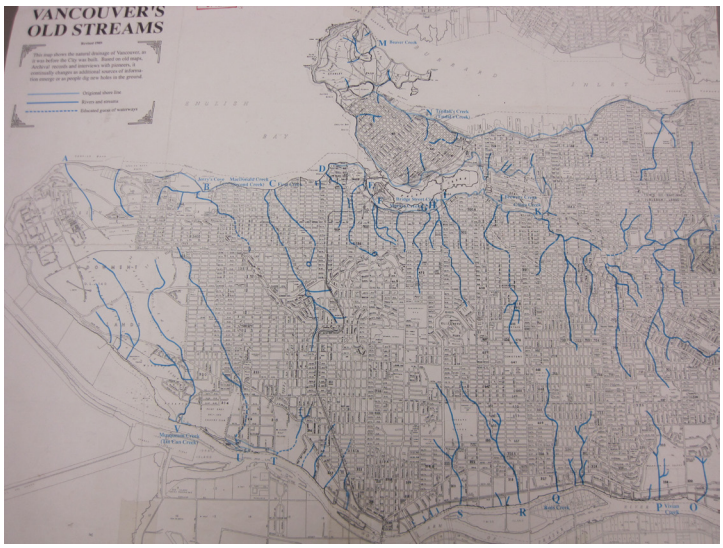

Figure 1. Vancouver's Hidden Streams. The blue lines indicate small urban streams hidden under the Vancouver's developed landscape. Source: Harris (1987).

Although studies suggest that stream daylighting projects result in measurable environmental improvements, there are also reasons to question whether stream daylighting is effective in realizing urban conservation goals. "Conservation," as defined by Scott Jones, is "the [effort] made to improve habitats for wildlife species

under threat" (2). Daylighting projects failed to expose entire watersheds, provide adequate buffer zones, or create substantial corridors between daylighted streams and other waterways; in nine of the eleven streams studied for his urban planning masters' thesis (Jones 39). Furthermore, the focus on preserving exotic riparian sites and species frequently led to the creation of habitats that failed to conserve typical local species (ibid. 22). Jones's findings also indicate that stream daylighting projects often fail to provide adequate structural biodiversity to create and maintain a variety of riparian species (22). Additional environmental disadvantages include the potential for altered sediment patterns to adversely affect downstream aquatic species (Pinkham, "New Life for Buried Streams" 35). Finally, it has been observed in San Francisco that additional ground water flows resulting from stream daylighting projects have the potential to "stir up toxic pollutants" hidden in the soils of industrial regions, to the detriment of local habitats (Baume).

Thus, although studies have concluded that stream daylighting tends to improve ecological habitat and increase biodiversity, we must question whether daylighting contributes measurably to urban conservation goals. As Jones concludes, "there is little reason to pursue daylighting as a way of providing habitat for urban wildlife… and when considering spending money on urban conservation, planners need to carefully consider their options" (31).

Social Advantages/ Disadvantages

Although case studies indicate that stream daylighting projects are less successful in creating urban conservation areas than might be expected, research does suggest that stream daylighting is of substantial social benefit to urban communities (see Table 1). A considerable social benefit noted in several daylighting studies was the creation of a space for children to play (Pinkham, "New Life for Buried Streams" 32). According to Anne Riley, executive director of the Waterways Restoration Institute, playing along streambeds offers children a valuable "formative experience" unobtainable within traditional playgrounds ("Stream Spirit Rising"). Daylighted streams are also often utilized as a teaching tool by neighborhood schools (Pinkham, "New Life for Buried Streams" 4; "Stream Spirit Rising"). Furthermore, they may offer significant aesthetic appeal (Pinkham, "New Life for Buried Streams" 55; O'Neil and Gaynor 127). Daylighted creeks can also serve as urban corridors, and a means for communities to utilize previously inaccessible urban space. In the majority of stream daylighting projects, collaboration and cooperation between individual community members, development companies, and government officials builds a greater sense of community cohesion and the feeling of "righting the wrongs of the past"(Pinkham, "New Life for Buried Streams" vii; Fitzsimmons vi; Pinkham, "Opportunities for Pittsburgh" 2; National Parks Service; Register, "Balance with Nature" 5). Importantly, stream daylighting serves to 'reconnect' community members with nature (Jones 7). This last point is evoked by Jessica Hall, as she describes how the daylighting of the Arroyo River "brought to life the very feelings a creek can evoke, and ran it through the community [of Highland Park]" ("Stream Spirit Rising"). Finally, stream daylighting projects promote a sense of identity within communities. As Jessica Hall suggests, the presence of streams in an urban setting gives "the idea that there is a spirit" to a place (ibid.).

In their paper "The Pigeon Paradox: Dependence of Global Conservation on Urban Nature," Dunn et al. argue that global environmental sustainability is dependent on the ability of urban citizens to maintain a "connection with nature" (1814). The "pigeon paradox" refers to their belief that small scale urban restoration projects positively impact global environmental efforts through the opportunities they provide for ur-

ban residents to have a "direct experience with the natural world" (1814). They claim that when people are exposed to nature they are more likely to conserve it. According to this claim, stream daylighting projects serve a greater purpose in environmental conservation by providing a connection between urban populations and the natural environment, regardless of the local context.

Arguably, the social advantages of stream daylighting far outweigh the disadvantages, but it is important to recognize the social stressors that can result from these projects, the most prevalent of which is fear – specifically the fear that deep, fast moving water poses a risk to child safety (Pinkham, "New Life for Buried Streams" v). Other social concerns center on disruptions caused during the daylighting process, and the potential for open waterways to attract homeless people (ibid.v). Studies also indicate that community members may experience frustration over the growth of native vegetation that can leave the landscape looking "un-kept"' (ibid.8). Additionally, community disputes over site development strategies may provide an additional source of social strife (Register, "Balance with Nature" 25). Although such concerns are valid, it is important to note that the majority of these concerns tend to be expressed prior to a stream being daylighted. Once a project is completed, social concerns tend to be overshadowed by social advantages. As Palmer et al. suggest the rehabilitation of natural ecosystems through stream daylighting offers a "great benefit to human societies" (72).

Conclusion: The Complex Urban Attitude

Ultimately, this study illustrates the complexity of urban attitudes towards nature. The fact that stream restoration projects tend to provide more social advantages than beneficial environmental outcomes, suggests a human-centric motivation for these projects. However, the case has also been made that stream daylighting projects make an important contribution to global environmental awareness and are therefore reflective of an attitude of reverence and respect towards nature. So how does one conclude? Does today's urban population value nature only as it benefits them, or do members of the city undertake restoration projects to illustrate their awareness of the natural environment? Perhaps it is not one or the other, but both.

Ellen Whol suggests that, "rivers … reflect a people's history" (1). In the process of investigating the evolution of urban attitudes towards small urban streams, this study has illustrated the complexity of the urban disposition towards nature. It was determined through an assessment of the environmental and social effects of stream daylighting that today's urban attitudes towards streams are 'human-centric.' This finding, however, is complicated by the so-called pigeon paradox which suggests that stream daylighting contributes to a larger, global commitment to the environmental conservation effort on the part of urban citizens. Ultimately, this study concludes that urban attitudes towards the environment are continuously evolving, and should be understood at both the local and global scales.

Appendix A

	Successes/Advantages	Shortcomings/Disadvantages
Enviromental	• Improve ecological habitat (Pinkham, "New Life for Buried Streams"; Peel; O'Neil and Gaynor; Buchholz and Younos; Conradin and Buchli; Baume; Wild et al.) • Increase biodiversity (Pinkham, "New Life for Buried Streams"; Fitzsimmons; National Parks Service; Buchholz and Younos) • Improve water quality (Pinkham, "New Life for Buried Streams"), Fitzsimmons; Buchholz and Younos; Conradin and Buchli) • Improve air quality (Pinkham, "New Life for Buried Streams")	• Incomplete watershed restoration (Jones) • Damages caused during construction (Pinkham, "Opportunities in Pittsburgh"; "New Life for Buried Streams") • Emphasis on exotic species preservation (Jones) • Increased sediment transport (Pinkham, "New Life for Buried Streams") • Limited structural diversity (Jones) • Inadequate buffers (Jones) • Lack of wild life corridors (Jones) • Revitalization of hidden toxins (Baume)

Social	• Play space for children ("Stream Spirit Rising") • Aesthetic appeal (Pinkham, "New Life for Buried Streams"; "Opportunities in Pittsburgh"; O'Neil and Gaynor) • Educational opportunities (Pinkham, "New Life for Buried Streams"; "Opportunities in Pittsburgh"; "Stream Spirit Rising") • Community space (O'Neil and Gaynor) • Involvement of local businesses (Fitzsimmons) • Community cohesion (Pinkham, "New Life for Buried Streams"; "Opportunities in Pittsburgh"; Fitzsimmons; Water Resources Division; Register, "Balance with Nature") • A 'reconnection' with nature ("Stream Spirit Rising"; Pinkham, "New Life for Buried Streams") • Civic spirit and grassroots power (Pinkham, "New Life for Buried Streams"; "Opportunities in Pittsburgh"; O'Neil and Gaynor) • Community gathering place (Stream Spirit Rising) • Water to mask city noise (Wild et al.) • A sense of community identity (Wild et al.)	• Fear (Pinkham, "New Life for Buried Streams"; "Opportunities in Pittsburgh") • Attract homeless (Pinkham, "New Life for Buried Streams") • Long time species re-growth (Pinkham, "New Life for Buried Streams") • Native vs. exotic landscaping (Pinkham, "New Life for Buried Streams"; "Opportunities in Pittsburgh") • Contested land use (Pinkham, "New Life for Buried Streams"; Register, "Balance with Nature") • Frustration over longevity of project (Pinkham, "New Life for Buried Streams"; Wild et al.)

Table 1: Environmental and Social Advantages and Disadvantages of Stream Daylighting.

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GIS and Glacial Dynamics

ANALYSIS OF GLACIAL LAKE OUTBURST FLOOD TRIGGERING MECHANISMS FOR THE IMJA TSHO GLACIAL LAKE AND POTENTIAL EFFECTS ON THE DOWNSTREAM MORPHOLOGY OF THE STREAM CHANNEL

Jordan Elaine Booth and Lauren Jean Punt

Abstract: *Since glaciation in the Himalayas is in a period of retreat, glacial lakes are growing and potentially posing a large risk to downstream settlements. The mechanism of disaster is in the form of a Glacial Lake Outburst Flood (GLOF). The glacial lake Imja Tsho in Nepal has received a lot of media attention due to its projected probability of breach. This study seeks to determine through both quantitative and qualitative analysis whether or not the moraine-dammed Imja Tsho Lake has a high probability of breach and what this means for those residing downstream. The results of this study show that quantitative methods project a relatively low probability of moraine breach. However, qualitative methods show otherwise. We conclude that further studies should look to assess the impact of warming temperatures on possible triggering mechanisms for a GLOF.*

Introduction

Glacial lake outburst floods (GLOFs) - events caused by the breach of a moraine-dammed lake – have substantially shaped the Himalayan landscape over time; however, they haven't been studied in depth in Western literature until recently (Kattelmann). This is primarily due to the fact that they tend to occur in unpopulated, difficult to reach places (Clague and Evans). Recently, however, GLOF events have become potentially hazardous to many settlements in the Himalayan region due to rapid deglaciation (Kattelmann). A major issue currently facing Nepal is a warming trend in average temperatures. This trend has been the primary contributor to regional glacial retreat (Kansakar et al.).

Deglaciation in the Himalayas has caused the development of many glacial lakes scattered throughout the high alpine mountains of Sagarmatha National Park in Nepal. These moraine-dammed lakes have received a significant amount of attention from scholars and media alike for the increased likelihood of a GLOF affecting the Imja Khola river valley. The media has portrayed this as a very likely event, but there is debate among scholars. This study aims to add to the debate by performing a multifaceted analysis – a format that has been neglected in other studies to date – which looks at the interplay of several processes affecting the likelihood of a GLOF. The objectives of this paper are to identify possible GLOF triggering mechanisms, determine the probability of

the moraine-dam breaching, and to predict how the downstream morphology might change if a GLOF were to occur.

Background

Glacial lakes are formed within the glacial origin as it retreats and supraglacial melt collects in topographical hollows. Glacial structures, such as lateral and terminal moraines, act as barriers to the drainage of these ponds. As subsequent melt occurs, the ponds can coalesce to form a large lake (Richardson & Reynolds). GLOFs are catastrophic floods or debris flows triggered by the breaching, eroding, or over-topping of these moraine-dammed lake.

The focus of this study is in the eastern Khumbu Himal Region of Nepal. Two major tributaries, the Lhotse Shar glacier and the northeastern Imja glacier terminate at the glacial lake Imja Tsho (Hambrey et al.). The glaciers are fed directly by avalanches from slopes rising from 5000 m to more than 7000 m above sea level (Hambrey et al.). Historical map data shows that the lake developed rapidly from several supraglacial ponds (Yamada and Sharma; Watanabe, Ives, and Hammond). Bajracharya and Mool suggest that the Imja glacier retreated 34 m annually from 1962 to 2000, and 74 m annually from 2000 to 2007. This represents an average rate of retreat of 59 m annually, meaning the lake is growing rapidly at a rate of about 0.2 km2 per decade (Hambrey et al.), making it a likely candidate for breach.

Methodology

Triggering Mechanisms

We began with a review of selected literature to identify possible triggering mechanisms of moraine breach. The probability of these potential triggering events occurring at Imja Tschowas was then assessed using two methods: firstly by using a statistical model empirically derived by McKillop and Clague for moraine-dammed glacial lakes in southwestern British Columbia, and secondly by comparing its features with empirical data in the literature by Hambrey et al., Watanabe, Lamsal, and Hammond, and Richardson and Reynolds.

Probability of Moraine Breach

McKillop and Clague quantify outburst probability using a statistical model based on predictor variables for moraine-dammed lakes in southwestern British Columbia. Research of dam break models led us to determine that this dam break model was the most accurate because it describes characteristics of a glacial moraine dam. It should be noted, however, that using this model necessitates the assumption that the landscape of the Coastal British Columbia is analogous to that of the Sagarmatha region in the Nepali Himalayas. The model's output describes the likelihood that the glacial lake will drain disastrously, but is unable to specify when since there is little known about the recurrence intervals of moraine-dammed lake breach.

By inputing the values collected for Imja Tsho region into the model proposed by McKillop and Clague, we calculated a probability outburst for the Imja Tsho Lake using the following logistic regression analysis equation:

$$P(Y = 1)_{(1)} = \left\{1 + e^{-[\alpha + \beta_1(M_{hw}) + \Sigma\beta_i(ice_{core}) + \beta_2(Lk_{area}) + \Sigma\beta_k(geology_k)]}\right\}^{-1}$$

where [alpha] was the intercept, $ß_1$,$ß_2$,$ß_i$, $ß_k$ and were regression coefficients for M_{hw} (ratio of lake surface height to moraine width), Lk_{area} (lake area), Ice_{core} (ice present or absent in the moraine), and $Geology_k$ (lithology of the moraine). Values for M_{hw} and Lk_{area} were measured directly from Google Earth, while indicator values were used for Icecore and Geologyk. Icecore is assigned a value of 1 if ice exists in the moraine and 0 if there is none. Geologyk is assigned a value of 1 for granitic, volcanic, sedimentary, or metamorphic ma-

terial, and 0 for any other material. Input values, including surface area, dam height, lake volume, moraine width, moraine height, elevation, and slope of the moraine fan, as well as data regarding landscape characteristics, including but not limited to geologic dynamics of the moraine, were obtained from a variety of sources (McKillop and Clague; Bajracharya, Shrestha and Rajbhandari; Hambrey et al.; Google Earth). The probability of the outburst was described qualitatively in order to avoid giving the impression of unrealistic precision. This was especially important, since the model we used was developed for terrain in British Columbia as opposed to the Himalayas.

For logistical reasons in obtaining data, some of the variables identified by Clague and Evans as affecting the probability of a moraine breach were not included in the regression model. For this reason, we used a comparative analysis based on empirical data as a secondary means of assessing the probability of a GLOF at Imja Tsho. A list of potential indicators of failure proposed by Grabs and Hanisch, and Richardson and Reynolds, was compiled and used to evaluate the relative holding strength of the lake. This list was then used to evaluate the likelihood of a GLOF based on the presence of these same indicators in the Imja Tsho area. The risk of a GLOF was assessed as 'high' if these indicators were present in the lake and surrounding landscape. Indicators such as a relatively large volume and surface area of the lake, the presence of dead ice buried beneath the dam, low dam width, high dam height, and piping of the moraine dam were considered significant in assessing the probability of moraine breach resulting in a GLOF (Grabs & Hanisch; Richardson & Reynolds). Piping refers to lengths of unconsolidated material within the moraine that are noticeably weaker and more susceptible to failure than the surrounding material.

Downstream Morphology

Finally, the nature of the breach zone was assessed to determine whether there was sufficient sediment and slope to initiate debris flow in Imja Khola, the valley and stream channel below Imja Tsho. To supplement this analysis Costa's peak discharge equation was used, and the results compared with peak discharges observed in the flooding of the adjacent Langmoche Khola valley (McKillop and Clague). Langmoche Khola, a neighboring stream that connects with Imja Khola near the village of Namche Bazaar, was chosen because the two channels have similar morphologies. A side-by-side image comparison of the channel reaches was performed to deduce how erosion and deposition might occur if the Imja Tsho lake were to burst. This analysis was informed by the relevant information in the literature by McKillop and Clague, and Anthony, and the images were sourced from Google Earth. To begin, we captured an image of each river valley from the same altitude to ensure they were the same scales. We then captured larger scale images of both the beginning reaches and the most downstream reaches to aid in our visual analysis of the stream channels.

Results

Triggering Mechanisms

Several processes capable of triggering a GLOF event were identified in the literature. These mainly consisted of mechanisms that could displace the lake enough to overtop the moraine dam, including mass wasting processes such as avalanches and rock falls, or calving of the glacial tongue. In this situation calving would occur if the glacier terminus was undercut by the lake water and destabilized. Additionally, piping could reduce the stability of the moraine itself, making it more vulnerable to seismic activity.

Mass wasting processes linked to steep alpine

relief are characteristic of the slopes surrounding Imja Tsho. Photographic analyses indicate that diffusive processes prevail on these slopes; there is evidence of talus accumulation at the bottom of the southern slope. Imja Tsho is bordered by high lateral moraines, which prevent up-slope processes from disturbing the lake (Hambrey et al.). However, these unconsolidated lateral moraines risk failure if a large enough deposit were to disturb their stability.

Richardson and Reynolds commented that over 53 percent of the GLOFs they studied in the Himalayas were triggered by displacement due to calving of the glacial tongue. There is a distinct possibility of this happening at Imja, as the surface of Imja's tongue is approximately 40m above the lake water level and so would result in a very large surge of water.

Piping is difficult to infer remotely or even during field mapping, but is likely present in Imja's terminal moraine judging by the hummocky surface. Data gathered from the United States National Oceanic and Atmospheric Association to determine if piping could reduce the stability of the dam shows a strong trend of high-magnitude earthquakes in the vicinity. Prevalent seismic activity is likely to exacerbate piping and reduce the stability of the moraine. Piping may also be worsened by seepage of water through the dam. Imja's dam has a partial ice core; any melt that occurs here may seep out of the unconsolidated layers and reduce stability (Watanabe, Ives, and Hammond).

Moraine Breach Probability

In order to predict the probability of a moraine breach at Imja Tsho, the values in Table 1 (Appendix A) were used as inputs for McKillop and Clague's regression model.

Inputting the data presented in Table 1 to Clague's regression analysis shown in Equation (1) we found the probability of a moraine breach to be equal to:

$$P(Y=1)=\left\{1+e^{-[-7.1074+9.4581(.027)+\Sigma-1.2321(1)+.0159(103)+\Sigma 3.7742(1)]}\right\}^{-1} \quad (1)$$

$P = 6.5\%$

According to the parameters set by McKillop and Clague, a 'low' probability of moraine breach is defined as one between 6 and 12%, so our calculations predict a low probability of outburst at Imja Tsho.

Contrary to the quantitative analysis, which shows a low probability of outburst, the qualitative data presented in Table 2 (Appendix B)indicates that Imja Tsho presents many of the features characteristic of potential outbursts. Evidence of an ice cored moraine, large lake volume, and proof of a calving glacier are all high potential indicators for a GLOF (Grabs and Hanisch; Richardson and Reynolds).

Downstream Morphology

Sediment storage and slope are factored into estimates of the likelihood of a debris flow. While there is enough sediment at Imja to initiate a debris flow, the slope below the moraine is not steep enough. Ten degrees is the minimum slope to initiate a debris flow and the slope was measured at 0.09 degrees (McKillop and Clague; Google Earth). Thus, if an outburst were to occur it would be in the form of a flood and not a debris flow. Using Costa's equation, we calculated the peak discharge that would occur if there was a flood.

$$Q_p = .00013(PE)^{.60} \quad (2)$$

where Q_p is peak discharge (m^3/s), and PE is the potential energy of the lake water (Joules), which is the product of dam height (m), lake volume (m^3), and the specific weight of water (9,800 N/

m^3). The dam height is 56.25 meters (Hambrey et al.), the lake volume is 35.8 million m3 (Bajracharya et al). Therefore using equation (2) peak discharge can be estimated as:

$$Q_p = .00013\left(56.25m \times 35.8 \times 10^6 m^3 \times 9800\frac{N}{m^3}\right)^{.60}$$

$$Q_p = 12{,}333.386\frac{m^3}{s}$$

Since Imja Khola has very similar channel morphology to Langmoche Khola, Langmoche Khola was used as a proxy to determine what would happen in the event of a flood at Imja. The upper reach of Langmoche Khola, where a GLOF occurred 31 years ago, has the same channel morphology and we have assumed that Imja would be affected similarly by a GLOF. The upper reach of Imja Khola has a broad valley floor with a low gradient. The sediment appears to be unconsolidated sands and gravels. Further downstream at Imja Khola, the valley walls are steeper and the stream is more confined. At Langmoche Khola, the GLOF eroded the upper reaches of the valley laterally because of the high flow velocity just below the dam breach. Downstream in the Langmoche valley the GLOF heavily scoured the valley walls; there was little deposition because the channel is confined by bedrock. The entrained sediment from this reach was deposited downstream, where the valley opened up again. If a GLOF was to occur, Imja would likely experience similar effects.

Discussions

Moraine Breach Probability

The low probability of an outburst flood calculated quantitatively for this region did not match well with our qualitative analysis, which indicated a high likelihood of potential flooding. Given that the regression model predicts a lower nominal value than we expected for Imja Tsho based on the qualitative analysis, we conclude that a lower probability of outburst exists for Imja Tsho than some scholars first indicated (Yamada and Sharma). This conclusion is informed primarily by the low height to width character of the moraine in question. A similar conclusion was drawn by Hambrey et al.

There are uncertainties regarding each method. Problems occurred when trying to reproduce McKillop and Clague's regression analysis simulated for two example locations in their paper. Using the authors' stated methodology, our own calculations did not reproduce their probabilities of 52 and 61 percent. Instead our calculations yielded 54 and 88 percent, respectively (see McKillop and Clague for details on the simulation of their model). After repeated verification of our own inputs and calculations proved unsuccessful in reproducing their findings, we attributed these discrepancies to either publisher's error or to errors in the software modeling program they used.

Despite these discrepancies, the quantitative analysis is still needed since a negative aspect of a purely qualitative analysis is that all variables are assumed to have the same weight. Evidence of all but one indicator for a high potential outburst does not necessarily mean that the lake will likely burst, since the one indicator that is absent may be the most important factor determining potential triggering. For example, while the moraine width to height ratio was one of the most important indicators in McKillop and Clague's equation, it was one of the only indicators that was not evident in Imja Tsho basin. Thus, the expected potential for dam breach obtained from the qualitative analysis can be lowered significantly.

Downstream Morphology

Our calculated peak discharge is more than double that of other peak flows reported in the literature for similar floods. We attribute this difference to the fact that Costa's equation uses parameters instead of direct variable measurements,

such as kinematic wave velocity of the flood, wetted cross-sectional area, wetted hydraulic radius, and Manning's roughness coefficient. For example, Bajracharya et al. calculated a peak discharge for Imja Tsho of 5463 m^3/s, a value which is much closer to the peak discharge recorded at the Langmoshe outburst flood that was estimated to be 2250 to 2400 m^3/s (Anthony). The peak discharge (Q_p) used by Bajracharya et al. is calculated using the Simplified Dam Break Model (SMPDBM). The SMPDBM computer-based model computes peak outflow at the dam using a variety of variables within its database. An advantage of this model is that it combines channel properties with peak flow routing curves to determine changing flow as the morphology downstream fluctuates (United States of America, "Simplified Dam-break"). This modeling system would have been extremely beneficial for the results of our analysis; however, we were unable to gain access to the software.

Assuming that Imja Khola would be affected by a GLOF similarly to the effect on Langmoche Khola, we can conclude that the villages in the study area (Dhusum and Dingboche) would likely suffer severe damages, since in both instances the villages are located on cut banks within 7 km of the moraine dam. In Langmoche Khola, the cut banks were heavily eroded as the flood turned the corner of the valley.

Conclusions

We began this study based on the assumption that GLOFs are a likely hazard in the Himalayas. Our findings indicate that while GLOFs do represent potential hazards, the probability of a GLOF is perhaps less likely than at first suspected based on observed indicators at the Imja Tsho. While the qualitative analysis indicated that there are many indicators for a possible GLOF event, the quantitative results suggested a low probability of moraine breach. However, we believe it should still be closely monitored for gradual changes since on a long term (decadal) time scale, the probability of a moraine breach may increase due to the increased surface area of the lake resulting from glacial retreat due to climate warming. As well, the inner part of the ice core is narrowing (Hambrey et al.), which will cause the moraine dam to become more unconsolidated in the future. Unconsolidated sediment is less stable and would therefore be more prone to failure. More research should be conducted in this area, given the uncertainties noted not only in our own analysis but in differing opinions within the literature (Yamada and Sharma; Bajracharya, Hambrey et al.), and for the well being of the inhabitants downstream since, if it did flood, it could pose a serious threat.

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Appendix A

Lake surface to moraine toe (Elevation gain from lake surface to toe of moraine dam) (Clague and Evans)	19m (Hambrey et al.)
Moraine width (Horizontal distance between distal lakeshore and toe of moraine dam) (Clague and Evans)	707m (Hambrey et al.)
Lake Area (Clague and McKillop)	103ha (Hambrey et al.)
Ice-cored moraine (Kattelman, 2002)	Yes. Assigned value 1 (Hambrey et al.)
Bedrock lithology surrounding and upstream of lake (McKillop and Clague)	Sedimentary. Assigned value 1 (Hambrey et al.)
Moraine height- to-width ratio (ratio between moraine height and width) (Clague and Evans)	0.27

Table 1. Variables and regression coefficients describing the lake and the moraine dam at Imja Tsho (Adapted from: McKillop and Clague).

Appendix B

Indicator	Imja Tsho	Source
Unconsolidated Moraine Dam	Yes Terminal moraine composed of basal glacial and super glacial sediment from the Little Ice Age.	(Yamada and Sharma; Hambrey et al.)
Contact with Active Ice Body	Yes Imja Tsho is at the base of the glacial tongue.	(Google Earth; Bajracharya, Shrestha and Rajbhandari; Hambrey et al.)
Steep Glacial Tongue	No Surface gradient of tongue less than two degrees.	(Google Earth; Hambrey et al.)
Glacial Drainage into the Lake	Yes Depressions indicate supraglacial meltwater tunnels and ponds. Complex englacial meltwater systems discharge into the lake.	(Yamada; Hambrey et al.)
Calving Glacier	Yes Evident at ice bound cliff at Lhotse and Imja glacier.	(Hambrey et al.)
Large Lake Volume	Yes At a volume of 35.8 million m3 Imja Tsho is one of the fastest growing lakes in the region.	(Bajracharya, Shrestha and Rajbhandari; Bajracharya and Mool)
Limited Freeboard between the Lake Level and Crest of the Moraine Ridge	No Freeboard is about 600 meters across.	(Shrestha)
Strong dam seepage	Yes Evidence of fluvial erosion.	(Watanabe, Lamsal, and Hammond)
Stagnant Glacier Ice within the Dam	Yes The end moraine is 600 m wide and has an extensive dead ice core which is often exposed.	(Sakai et al.; Bajracharya, Shrestha and Rajbhandari; Hambrey et al.)

Table 2. A qualitative list of failure indicators used to determine the relative holding strength of Imja Tsho.

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IDENTIFYING AREAS FOR TRANSIT-ORIENTED DEVELOPMENT IN VANCOUVER USING GIS

Victor Douglas Ngo

Abstract: *Transit-oriented development (TOD) is emerging as a popular and influential planning idea across North American cities as a means of sustainable urban development. Given concerns about urban sprawl and high ecological footprints, pursuing TOD has proven to be an effecti e way of concentrating growth on brownfield sites while generating and attracting transit ridership to shift mode share. In the city of Vancouver, the SkyTrain rapid transit system has shaped land use planning since its inception in 1985. While development that capitalizes on rapid transit has been successful in the downtown core, stations beyond the peninsula have yet to pursue TOD to its full potential. Given the projected population increase from about 578,000 in 2006 to 740,000 by 2041, identifying areas for TOD is becoming increasingly important for long-term planning. Using a Geographic Information System (GIS), a multi-criteria evaluation was conducted to assess TOD performance in Vancouver and identify stations that would benefit from intensifying and optimizing TOD. Six criteria were selected to capture the ideal social and physical dimensions: walkability, bikeability, population aged 15 to 24, household income less than $40,000, recent immigrants from 1996 to 2006, and low density housing The MCE identifies ten stations o TOD intensification potential*

Introduction

Transit-oriented development (TOD) is emerging as a popular and influential planning idea across North American cities as a means of sustainable urban development. TOD is generally defined as moderate to high-density, mixed-use residential and commercial development located around a transit station or corridor. Representing the full integration of land use and transportation planning (Jacobson and Forsyth 53), it encourages a compact and pedestrian-oriented form that provides enhanced access to residential, retail, office, and community uses nearby. This encourages less automobile dependency and reduces greenhouse gas emissions. Effective TOD can thus maximize node and place functionality, where TOD serves as both a node within a larger transportation network, and as a place where vibrant urban life occurs (Chorus and Bertolini 47). Given current concerns about urban sprawl and high ecological footprints, pursuing TOD has proven to be an effective way of concentrating growth on brownfields for energy-efficient urbanism while generating and attracting transit ridership to shift mode share (Dittmar and Ohland 1; Lund 357; Petsch, Guhathakurta, and Hagen 65).

TODs are typically laid out in circular or nodal arrangements, located within a radius of 400 to 800 meters, equivalent to a 5 to 10 minute walk (1300 to 2600 feet) from a rail-based transit stop (Muley, Bunker, and Ferreira 6). A distinction is

made between transit-oriented development and transit-adjacent development (TAD) (see Table 1). The latter is "physically near transit [but] fails to capitalize upon this proximity… [It] lacks any functional connectivity to transit, whether in terms of land-use composition, means of station access or site design" (Cervero, Ferrell, and Murphy 6). Instead of promoting a more vibrant and sustainable urban form, TAD is described as conventional, automobile-oriented development located near transit stations. An example would be a transit station located in a single-family zoned neighbourhood with little to no amenities nearby.

Transit-Oriented Development	Transit-Adjacent Development
Grid street pattern	Suburban street pattern
Higher densities	Lower densities
Limited surface parking and efficient parking management	Dominance of surface parking
Pedestrian- and bicycle-oriented design	Limited pedestrian and cycling access
Mixed housing types, including multi-family	Mainly single-family homes
Horizontal (side-by-side) and vertical (within the same building) mixed use	Segregated land uses
Office and rental, particularly on main streets	Gas stations, car dealerships, drive-through stores and other automobile-focused land uses

Table 1. Comparing TOD and TAD. Source: Victoria Transport Policy Institute (adopted from Renne 3)

Despite clear environmental advantages, there are equity concerns associated with TOD that may conflict with social justice goals. Foth conducted a shift-share analysis on the long-term demographic changes of census tracts within the proximity of SkyTrain stations (48). She found lower-earning and less-educated occupants were displaced from 1981 to 2006 due to new development spurred by the introduction of transit. TOD can disproportionately favour individuals and families who are able to pay the extra premium to live in valuable real estate proximate to rapid transit. Subsequently, lower income households have limited locational choices as they get pushed further away from better served transit areas, resulting in less equitable transit access for the less affluent (Foth 40; Garrett and Taylor 8; Grengs 52).

The Vancouver Context

The region's three major SkyTrain rapid transit lines—Expo, Millennium, and Canada—service Vancouver with 20 stations present within the city boundaries. The Expo Line opened in 1985 for Expo 86, the Millennium Line opened in 2002, and the Canada Line in 2009 for the 2010 Winter Olympics. According to TransLink's 2004 Trip Diary Survey, for the city overall, walking and transit each make up 17 per cent of all trips while cycling accounts for 3 per cent (City of Vancouver "Vancouver 2020" 33). For trips to downtown, transit accounts for 30 per cent, walking for 27 per cent, and biking for 3 per cent (Klimchuk).

While development to capitalize on rapid transit in the downtown core has been successful, stations beyond the peninsula have yet to pursue TOD to its full potential. With a projected population increase in the city from about 578,000 in 2006 to 740,000 by 2041 (Metro Vancouver 68), future growth can be concentrated along transit corridors where neighbourhoods within station catchment areas would be able to benefit from a more complete and intense mix of residential, retail, office, and community uses. More pertinently, as automobile dependency decreases and transit ridership increases through smarter land use and transportation planning, multi-scalar greenhouse gas reduction and sustainable mode share targets

are more attainable at the provincial (2007 BC Greenhouse Gas Reductions Target Act), regional (2011 Regional Growth Strategy), and municipal (1997 Transportation Plan, Greenest City 2020 Action Plan) levels.

Accordingly, assessing areas to improve and/or optimize TOD in the city is becoming increasingly important for long-term sustainability and climate change planning. Towards this end, a Geographic Information System (GIS) was used to conduct a multi-criteria evaluation to assess TOD performance in Vancouver and identify potential stations that would benefit from intensifying and optimizing TOD.

Methodology

Multi-criteria decision analysis is a useful conceptual framework for making decisions by evaluating multiple and often conflicting criteria. Using a multi-criteria evaluation (MCE) method in a GIS environment can accommodate large amounts of information and provide a structured, traceable, and flexible analysis. This makes MCE an effective spatial decision support tool in a multi-stakeholder environment. Planners, politicians, the public, and other stakeholders can use models to determine ideal solutions to regional, city, neighbourhood, and community problems. Five steps are involved:

1. Determine criteria (factors and constraints) to be included
2. Normalize criteria standardized scores
3. Determine weights for each criteria
4. Evaluate using MCE algorithms
5. Conduct a sensitivity analysis to assess confidence of results

ESRI ArcGIS 10 was used to conduct the analysis using six criteria. Four criteria were selected from the 2006 census at the dissemination area-level: population aged 15 to 24, household income less than $40,000, recent immigrants from 1996 to 2006, and low density housing. The fifth criterion was derived from Frank et al.'s walkability index ("Neighbourhood Design" 5), while the final criterion was derived from Winters et al.'s bikeability index. These criteria were selected to capture the social and physical dimensions of an ideal TOD.

Certain segments of the population have a higher propensity to adopt sustainable transportation modes. The 15 to 24 age group represents the most likely group to travel using sustainable modes. In Canada, 35.1% of this group across all major census metropolitan areas walk, cycle or use transit to get to work. In Vancouver, they represent 36.7% (Statistics Canada). Similarly, recent immigrants are more likely to use public transit, even after controlling for demographic characteristics, income, commute distance, and residential distance from the city centre (Heisz and Schellenberg 3; Kim 165).

In the reality of peak oil, volatile gas prices, rising cost of living, and an unaffordable housing market in Vancouver (Cox and Pavletich 3), automobile ownership may become more difficult to maintain in the future as households become financially stressed. While TOD can be expensive to develop and generates a high demand and real estate value, it is necessary to ensure future developments in Vancouver are equitable and within reach of lower income households. As such, households that have an income of less than $40,000, an approximate threshold for Vancouver's living wage of $18/hour, were chosen ("Vancouver's living wage").

Pertaining to physical dimensions of TOD, single-detached family dwellings are characteristic of undesirable land use patterns due to the fact that they are typically low density and unable to support a cost-effective transit ridership rate. As classified by Statistics Canada, the presence of high proportions of seven housing types indicate

high potential for TOD intensification:

- Single-detached,
- Semi-detached,
- Row house,
- Apartment - duplex,
- Apartment - fewer than five storeys (includes single-detached homes with secondary suites),
- Other single-attached, and
- Movable dwellings.

Statistics Canada's eight housing type, apartment - five or more storeys, was excluded as it satisfied the requirements of an ideal TOD for this study.

Lastly, because TOD is intended to promote walking, biking, and transit, it is important to ensure that these types of transformation will increase the walkability and bikeability of communities along transit corridors. Frank et al.'s walkability index ("Neighbourhood Design" 5) was modified for the study. It considers three factors ("Stepping" 1903):

1. Net Residential Density (dwelling units/acre);
2. Net Commercial Density (retail floor area ratio);
3. Land Use Mix (0-1, where a higher value indicates a more even distribution by square footage of land between land use types).

Winters et al.'s bikeability index considers five factors:

1. Bike Route Density (metres of bike route);
2. Bike Route Separation (no separated path; separated path);
3. Connectivity (# intersections of local streets and bike paths);
4. Topography (% grade: rise/run);
5. Destination Density (# parcels of commercial, education, office, entertainment land use).

High proportions of youth, recent immigrants, and lower income households, and low proportions of low density housing are imagined to be found in an ideal TOD. Therefore, areas that presently have a higher proportion of these criteria indicate higher potential for TOD intensification. Each criteria layer was converted to raster in the GIS and normalized by total population (total occupied dwellings in the case of housing) of the DA. The layers were reclassified to a scale from one to 10, where one had the least potential for TOD intensification and 10 had the most potential.

Given the variables captured in the walkability index are highly correlated with one another, a standard score was calculated and summed. Interpolation by kriging was done to generate an appropriate raster. Both walkability and bikeability were reclassified from one to 10, so a high score of 10 indicated presently low walkability/bikeability levels, and thus the most potential for TOD intensification, and vice versa. All raster criteria layers were at 10 meter resolution.

Three buffers were generated at 400, 600, and 800 metres (equivalent to a five to 10 minute walking radius) around the SkyTrain station to represent the catchment area and potential TOD land. Weights were then generated (see Table 2) and assigned for a total of 100% using the analytical hierarchy process (Saaty 85), a structured technique using pairwise comparison. A consistency ratio of 0.08 was achieved, indicating the weighting was logically consistent relative to each criteria.

Criteria	Weight
Walkability	17.7%
Bikeability	3.71%
Population aged 15 to 24	11.76%
Household income less than $40,000	9.81%
Recent immigrants from 1996 to 2006	9.81%
Low density housing	47.21%

Table 2. MCE criteria weights.

In reality, this is the most arbitrary stage of an MCE and the most controversial; this is only one possible weighting scheme. The more criteria included, the more complex the weighting scheme becomes. When MCE is implemented in a public setting for policy and design decisions, input from all stakeholders is crucial.

Lastly, using the Weighted Sum tool in ArcGIS, all the layers were overlaid on top of each other, multiplied by their given weight, and summed together using the following expression:

TODx = [17.7 * (Wx)] + [3.71 * (Bx)] + [11.76 * (A15_24x)] + [9.81 * (LIx)] + [9.81 * (RIx)] + [47.21 * (LDHx)]

Where TODx is the potential for TOD intensification, Wx is Walkability, Bx is Bikeability, A15_24x is Population Aged 15 to 24, LIx is Household Income less than $40,000, RIx is Recent Immigrants from 1996 to 2006, and LDHx is Low Density Housing.

One constraint specified for the MCE was that results had to fall within the maximum 800 meter buffer. Therefore, results that were outside of the SkyTrain catchment areas were removed. A sensitivity test was conducted using an equal weighting scheme at about 16.6% to explore how a different set of weights would affect the results.

Results

The results did not drastically differ from the sensitivity analysis, indicating reliability of the results as defined by the criteria selected.

Low density housing is the most characteristic of non-TOD so it was assigned the highest priority. Walkability was considered a higher priority than bikeability given that walking forms the basis of all transportation, whether by bike, transit, or automobile. Income and immigrants were equal, but were less favoured than population aged 15-24 given that youth have a higher propensity to make sustainable transportation choices.

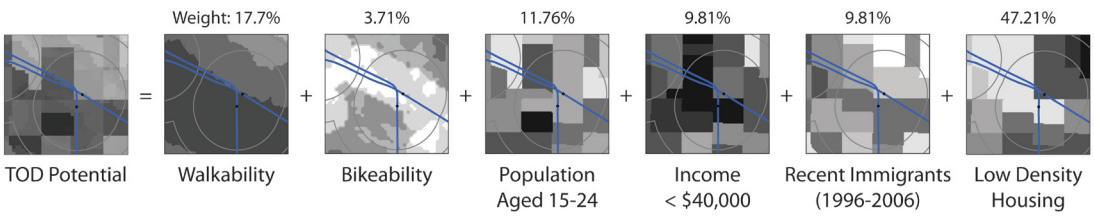

Figure 1. Weighted multi-criteria evaluation equation.

Discussion

Overall, the results are not entirely surprising. Ten stations that have moderate to high potential for TOD intensification are identified:

- Expo Line: Commercial-Broadway, Nanaimo, 29th Avenue, Joyce-Collingwood;
- Millennium Line: VCC-Clark, Renfrew, Rupert;
- Canada Line: Oakridge-41st Avenue, Langara-49th Avenue, Marine Drive.

Density is a contentious topic in the city, earmarked by neighbourhood opposition and discussions over housing affordability, gentrification, and neighbourhood character. These types of high-density developments are met with special apprehension by the communities directly affected by such transformations. By using evidence-based planning rationale, employing effective cartography, ensuring transparency, and setting discussions in the context of climate change planning, the results can contribute to fostering informed community dialogue around the role of increased density.

Examination of the results should be concerned with the general trend of TOD potential around a station, and not at a fine scale due to the irregular shapes of census DAs. For the Expo Line, Nanaimo and 29th Avenue scored high for TOD intensification potential. Given that the two stations opened in 1985—27 years ago as of 2012—

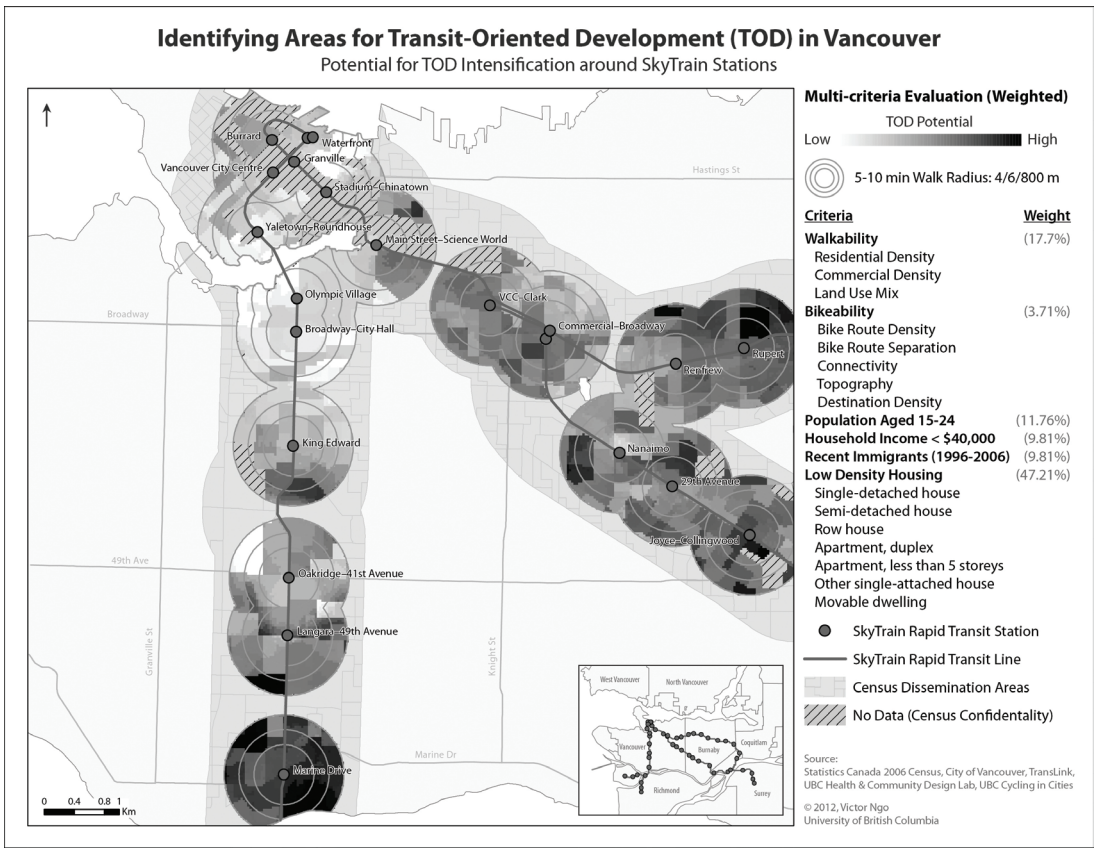

Figure 2.Weighted MCE results.

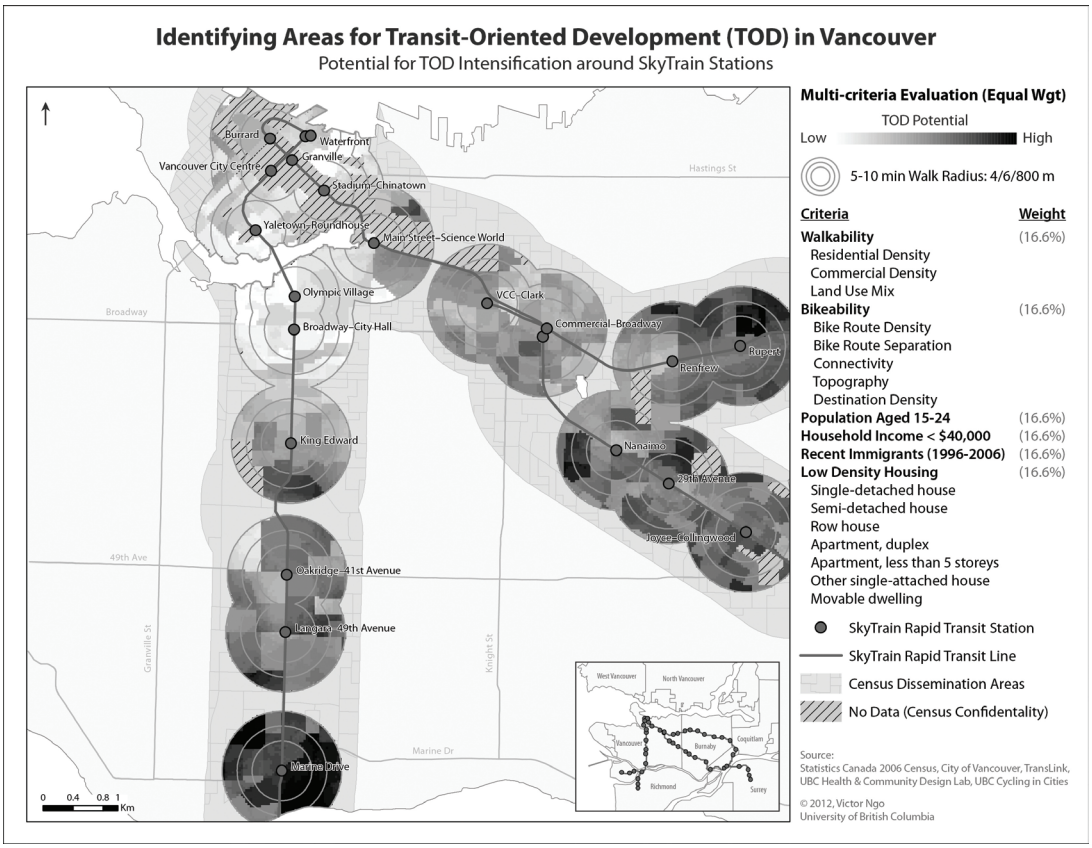

Figure 3.Equally weighted MCE results.

much can be done in these areas to encourage new, mixed use development to take advantage of rapid transit such as incremental upzoning from single-family to multiple residential dwelling, and/or mixed commercial. These stations are currently more characteristic of transit-adjacent development than TOD.

Similarly, land use surrounding VCC-Clark, Renfrew and Rupert station along the Millennium Line are at risk of remaining relatively static and not fully capitalizing on TOD possibilities. However, given discussions over extending the Millennium Line at VCC-Clark to the University of British Columbia and the completion of a 17-acre business park at Renfrew, this may change future assessments.

At Joyce-Collingwood station, the Collingwood Village TOD is considered a successful marriage of land use and transportation planning with a mix of high-rise and mid-rise buildings (Berelowitz 119-120). The community has been well documented for its success of social inclusion of immigrants and low-income individuals and families through the Collingwood Neighbourhood House (Sandercock and Attili 29). However, the general area around the station scored high for TOD potential attributed to the large number of single-family dwellings engulfing the immediate area surrounding the village. This may prompt a revisit of long-term community planning to maximize the area's proximity to rapid transit.

Opportunities for optimizing stations for TOD

may be hampered by existing land use barriers. The Commercial-Broadway station functions as a key transit junction for the entire Vancouver region, with a bus rapid transit line taking commuters to the region's second largest employment centre along Central Broadway and to a rapidly growing university campus. The 99 B-Line is the busiest bus route in North America, serving 50,000 passengers per day with a total ridership of 100,000 for the entire Broadway corridor when considering all bus routes (City of Vancouver "UBC Line" 2). While the area north of the station along Commercial Drive is known for its vibrant entertainment and cultural district, the area south of the station is much less so with a noticeable drop in lively street and pedestrian activity. A current barrier is the lack of a catalyst that has yet to come to fruition to spur vibrant commercial development. While the food retailer Safeway is not interested in selling the parcel it currently occupies, its existing location and accompanying parking lot beside the station would be a highly valuable parcel for the City and TransLink to acquire (personal conversation with city planner, 20 August 2011).

Lastly, the MCE identified Marine Drive to have the highest potential for TOD intensification in Vancouver. In response to the introduction of the Canada Line in 2009, the City passed the Cambie Corridor Plan in early 2011 as a coordinated planning strategy for the entire corridor. Representing the largest and most complex planning exercise ever outside the downtown core, the plan is the successor to the Vancouverism model that emphasizes mid-rise urbanism and the integration of land use, transportation, and energy through district and neighbourhood energy sources and systems (Villagomez; City of Vancouver "Cambie" 5). As part of the plan, the Marine Gateway development proposal was offered for the station and eventually passed by council. The 876,000 sq. ft. mixed-use development will provide residential, office, retail, and entertainment space (City of Vancouver "8440 Cambie Street").

The Cambie Corridor Plan has been controversial for local residents and generated intense public discussion over the question of density. The Cambie corridor has traditionally been a single-family neighbourhood, punctuated by a large shopping mall and a community college. Community concerns have been sparked by the dramatic increase in property values along the corridor, increased building heights, potential overshadowing, and the dramatic change to the neighbourhood character and identity. In relation to Foth's findings, concerted effort must be exercised to ensure sufficient stock of affordable and rental housing are available along the corridor to prevent displacement. The city's heated real estate market will likely exert downward pressure on affordability as it becomes more lucrative to sell units as full price. This may impede individuals and families in the city looking to rent or purchase, and affect local residents such as seniors, immigrants, and young families.

Prioritizing densification along transit corridors will be beneficial for long-term urban sustainability. Concentrating resources towards creating successful TODs will serve as useful precedents to deepen public acceptance of more sustainable urban forms, especially given that concerns regarding neighbourhood character preservation often run high in single-family districts. Notwithstanding, these types of transformations will need to acknowledge geographic circumstance and contingency. New development will inevitably take on different forms and emphasize a certain land use mix through a consideration of context and desired planning outcomes. There is no single formula for achieving ideal TOD. Hence, the selected criteria in the MCE aimed to capture social and physical dimensions of an ideal TOD. Accordingly, planning decisions should be guided by sound land use, transportation, energy, and design rationale; and alignment with environmental, economic, and social sustainability principles.

Conclusion

This study assessed the performance of transit-oriented development along the SkyTrain rapid transit system in the city of Vancouver and identified stations that would benefit from intensifying and optimizing TOD using a multi-criteria evaluation in a GIS. The five major findings are summarized below:

Ten stations are identified to have a moderate to high potential for TOD intensification: Expo Line: Commercial-Broadway, Nanaimo, 29th Avenue, Joyce-Collingwood; Millennium Line: VCC-Clark, Renfrew, Rupert; Canada Line: Oakridge-41st Avenue, Langara-49th Avenue, and Marine Drive;

Nanaimo and 29th Avenue station, despite opening in 1985 have not seen any significant changes in land use patterns and can be characterized as transit-adjacent;

- Potential exists to build on the success of Collingwood Village at Joyce-Collingwood station;
- Marine Drive station has the highest potential for TOD intensification;
- The Cambie Corridor Plan is a valuable opportunity to optimize the new Canada Line stations for TOD.

The results provide a useful visualization and quantitative assessment for city planners, politicians, and the public, and serve as validation in principle of past and current planning initiatives. Future research should expand the analysis to the entire region, consider applying finer-scale models to account for unique geographic contexts, and improve the resolution of census data using proxy data or other means to allow for parcel-level analysis.

Geographic Information Systems are a useful and powerful tool in guiding planning and policy decisions shaping long-term land use, transportation, and energy use. Implementing a public participation GIS using methods like multi-criteria evaluation to consider other criteria and different weighting schemes can improve the public process by enhancing planning literacy and engagement efforts. The versatility of GIS and rapid advancements in the development of new geovisualization techniques open many possibilities for public engagement. Offering transparency in analyses conducted by local governments may lend support from the public and assist in evidence-based decision-making for sustainability and climate change planning.

Acknowledgements

Thank you to Alejandro Cervantes for GIS assistance, Maged Senbel for contributing valuable insights, and Kevin Chan for his thoughtful editing. Cartographic design suggestions by Sally Hermansen were highly appreciated. Lastly, thank you to Dr. Larry Frank and Josh van Loon, and Meghan Winters who were kind enough to share their walkability and bikeability data.

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URBAN DEVELOPMENT IMPACTS ON THE SEA-TO-SKY GREENBELT: AN ANALYSIS OF THE FURRY CREEK, BRITANNIA BEACH, AND PORTEAU COVE MASTER-PLANNED COMMUNITIES

Lauren Weatherdon and Jonathan Walker

Abstract: *The study e aluates the land suitability of three proposed community developments—Furry Creek, Porteau Cove, and Britannia Beach—along the southern region of the Sea-to-Sky highway in coastal British Columbia. The assessment is based on two aspects: (1) the minim - zation of environmental impact in areas with rich biodiversity, and (2) the suitability of slope gradients for development purposes. The objecti e of the study was to produce an evaluation of the feasibility of development with respect to these two aspects, and to thereby provide a framework for further research towards the establishment of sustainable communities that preserve and integrate natural systems within urban armatures. Our analysis concluded that the Britannia Beach and Furry Creek master-planned communities were best situated with respect to incorporating natural systems while still maintaining economic feasibility. Further research is required to determine additional factors influencing the potential for de elopment (e.g., soils, hydrology, viewshed analysis) and to produce a detailed quantitative analysis of the development plans.*

Introduction

This project addresses the environmental impact of future urban development trends along the southern portion of the Sea-to-Sky highway (Highway 99) within the Squamish-Lillooet Regional District (see Figure 1). The communities of interest are located along Howe Sound between the municipalities of West Vancouver and Squamish. This region was chosen due to the significant vulnerability of unprotected land to future development (Smith 16). Because of this vulnerability, community watersheds with fish-bearing streams, spotted owl management areas, ungulate and other endangered species' ranges are currently at risk. For this reason, they have been included in the land suitability analysis for sustainable development.

With this context in mind, the objective of the analysis is to provide a tangible framework from which to pursue low-impact development solutions that take into account important ecological functions, as well as feasible developable surfaces based on slope topography. The result identifies key areas for conservation zoning, as well as areas that can withstand development with minimal environmental impact.

Through the identification of low-impact sites

for the master-planned communities of Britannia Beach, Furry Creek, and Porteau Cove, the analysis aims to assess the degree to which each of the proposed communities has the capacity to incorporate natural systems into its framework.

Data Collection and Preparation

Geoff Senichenko of the Wilderness Committee provided data collected through the Smart Growth BC Sea to Sky Greenbelt Initiative. Other primary sources included GeoBase (for elevation data) and Statistics Canada (for the base map of British Columbia). After collecting the data, a mask was created to clip the British Columbia base map to the area of interest (the Sea-to-Sky highway between West Vancouver and Squamish). Layers that were larger than the scope of the project (fish-bearing streams, spotted owl and old-growth forests, ungulate wintering habitat, conservancies, and rare and endangered species' habitats) were also clipped using the mask. A list of the data used during the analysis is provided in Table 1.

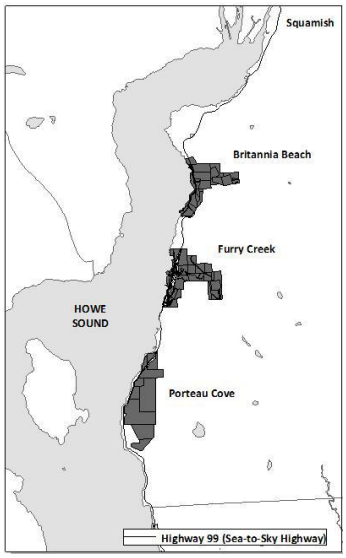

Figure 1. Map of the three master-planned communities located south of Squamish, British Columbia, on the Sea-to-Sky highway (Highway 99). (Sources: Wilderness Committee; Statistics Canada.)

GIS Methodology

Environmental Impact Analysis

Analysis of environmental impacts consisted of identifying and erasing sensitive habitats from the three master-planned communities. Six sensitive habitats were addressed: old-growth forests, spotted owl habitat, conservancies, rare and endangered species' habitats, streams (both fish-bearing and those without fish) and ungulate wintering habitat (which included mountain goats and mule deer located within the area of interest) (See Figure 2).

Streams were divided into two categories: those where the presence of fish had been confirmed and those where the presence of fish was unknown. Streams were buffered accordingly, with a 30-metre buffer being applied to the former and a 15-metre buffer to the latter. The latter buffer was selected due to both the uncertainty of fish presence as well as the essential role played by streams: they function not only as habitats for many organisms aside from fish, but also regulate the physical and chemical characteristics of aquatic resources and the infiltration of rainwater (Castelle 878-880; Condon 131-133). The Vermont Agency of Natural Resources lists stream buffer requirements ranging from 11 metres to 69 metres depending on which functions are to be preserved, while the University of British Columbia's Professor Patrick Condon, senior researcher with the Design Centre for Sustainability, identifies a minimum buffer width of 30 metres (with some suggested widths reaching 100 metres) as necessary in order to preserve the ecological functions of riparian habitats (Vermont Agency of Natural Resources [VANR] 26; Condon 132-133). The selected buffers of 15 and 30 metres fall within the minimum required range and are necessary to protect water quality and the capacity for temperature control, the latter being critical for spawning salmon (VANR 26).

Since spotted owls reside in old-growth forests, the overlap between the "old-growth forest" and "spotted owl habitat" layers allowed for the layers

to be joined through a 'union' overlay. A moderate 50-metre buffer was allocated to conservancies, ungulate wintering habitats, and rare and endangered species' habitats in accordance with conservation strategies and in order to provide a transition zone between residential land and natural ecosystems. This figure is below recommended buffer guidelines for protected terrestrial habitats: in Montana, land use policies restrict development within 1.61-kilometre-wide buffer areas around sensitive wildlife habitats, including county parks, wildlife refuges, and state parks (Prato 50-51). British Columbia's Ministry of Water, Land and Air Protection identifies sensitive habitat buffer zones of 200 metres for undeveloped land that is being developed into five-hectare lot sizes, and 60 metres for rural land (lot sizes of one to five hectares that are being further subdivided) (British Columbia Ministry of Water, Land and Air Protection 4-6).

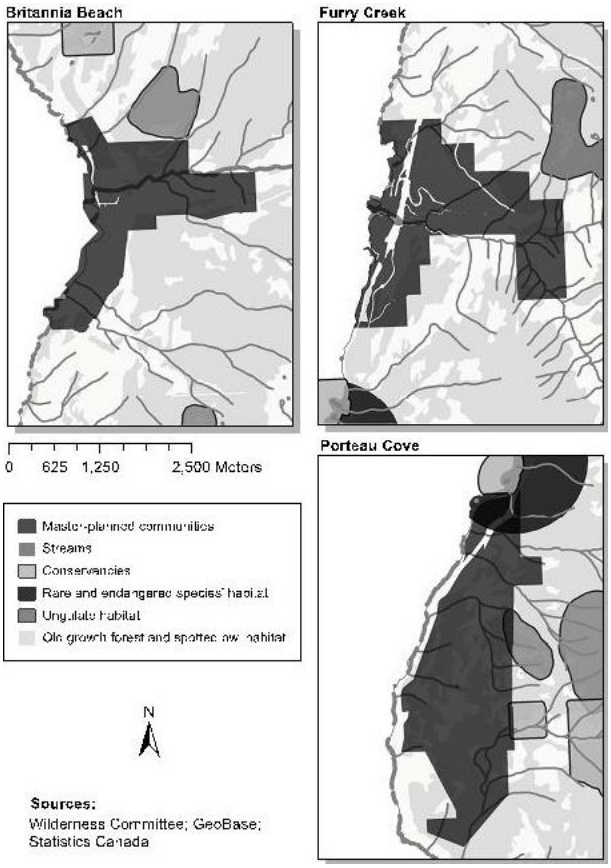

Figure 2. The three master-planned communities and their situation with respect to sensitive environmental habitats.

Once the five layers had been prepared, each was individually erased from each of the three master-planned communities: Furry Creek, Porteau Cove, and Britannia Beach. After completion, the remaining area and the area lost were calculated for each plan in addition to the percentage of area remaining. The operations were originally conducted in square metres; the values were then converted to hectares to better represent the change in area. The sequence of operations was carried out by two separate operators and repeated in order to minimize error and to ensure that the final results were consistent. Three summary tables were created outlining the changes in area.

Slope Analysis

In addition to environmental impact, slope is critical to the suitability of land for development purposes. Our analysis identified slopes equal to or greater than 22° as unsuitable for development in accordance with Smart Growth BC's restrictions (Smith 11). Digital elevation models supplied by GeoBase were converted to raster format and projected to NAD 1983 BC Environment Albers. The layers were then merged using the 'Mosaic to New Raster' tool. A slope surface was created and reclassified to slopes less than 22° (i.e. ≤ 21.999999°). The resulting layer was subsequently intersected with each of the three master-planned communities in order to determine the location of suitable slopes for development. The final area was calculated for each community and summary tables were created to resolve the issue of duplicate polygons.

Results and Discussion

Environmental Impact Analysis

The results of the environmental impact analysis are summarized on table 2(Appendix B).

The Britannia Beach master-planned community had the least amount of area overlapping with sensitive habitat, with 88.5 hectares erased due to environmental conflict (28.5% of the originally designated area). This is largely due to the strategic layout of the plan: the community is situated in such a way as to minimize contact with the surrounding old-growth forests, many of which provide habitat for the endangered spotted owl in addition to their function as a valuable commodity for carbon sequestration, recreation, and non-timber forest products (Knowler and Dust 5). The community is also located at the edge of the zone designated for ungulate wintering habitat, which includes a 50-metre buffer to allow for the transition between natural and urban environments. Overall, 71.5% (222.0 hectares) of the proposed area was found to be suitable for development with respect to environmental impact, providing the opportunity to create a community that embraces nature as a necessary component of its landscape.

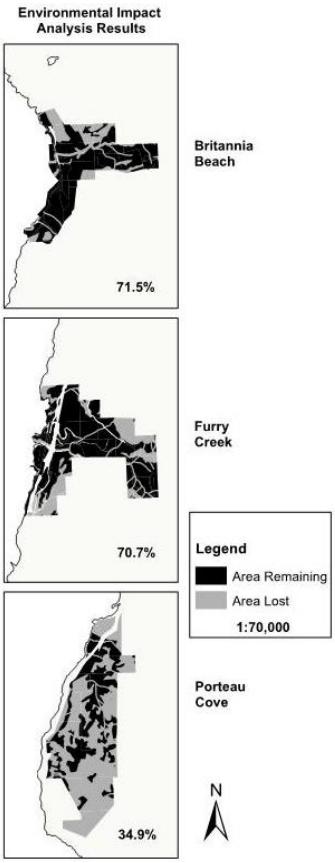

Figure 3 The results of the environmental impact analysis illustrate significant conflict with sensitive habitat in the Porteau Cove development proposal. Percentages indicate the amount of viable land remaining after the environmental impact analysis. (Sources: Wilderness Committee; Statistics Canada.)

A significant feature of the Britannia Beach community is the fish-bearing stream that runs through the centre of the proposed development area. Incorporating methods to reduce urban impacts—e.g., dry wells, vegetated swales, pervious surfaces, and abundant topsoil—would maintain the functions of this stream while simultaneously preserving an element of nature within the urban landscape (Castelle et al. 878; Condon 144, 147-149, 151-152). Failure to implement such methods would result in an increased rate of water flow to the stream that would overload its natural capacity, thereby inducing erosion of the riverbank and leading to a potential loss of biodiversity (Condon 133-135). The integrated greenway surrounding the stream would also offer numerous benefits to the community, including reducing the heat island effect, sequestering carbon, improving water infiltration, and increasing the general wellbeing of the community in terms of health, leisure, and mobility (Condon 124-125, 127-128, 131-133).

The Furry Creek master-planned community, like Britannia Beach, is well situated with respect to the natural environment. 29.3% (110.3 hectares) of the proposed development area overlapped with old-growth forests and streams; however, it is not known whether the plan intended for these elements to be incorporated into the community's infrastructure or to be replaced with residential properties. Also akin to Britannia Beach, Furry Creek has a fish-bearing stream as a central aspect of the community, of-

fering the same opportunities and requiring the same measures to ensure that the functionality of this critical habitat is preserved. After completing the erase operations, 70.7% (266.1 hectares) of the original plan remained as viable land for development.

The Porteau Cove master-planned community is of particular concern with respect to its relationship with the natural environment. Of the original 446.7 hectares proposed for development, 290.8 hectares (65.1%) overlap with critical habitat for endangered species (Myriogramme pulchra, a species of red algae; ungulates; and spotted owls), as well as streams and conservancies.

Methodology Analysis

Since the metadata for the datasets supplied by the Wilderness Committee were incomplete, the accuracy and original sources of many of the layers used are unknown. The data were originally gathered to evaluate the sustainability of the proposed developments, but the project was not completed due to budget constraints. For this reason, we have assumed that the datasets are relatively compatible with one another; however, it is important to note that some of the edges between layers do not align correctly. Furthermore, some of the data were originally collected through community surveys (e.g., point counts of fish in streams); consequently, the accuracy and completeness are unknown. The surveys may underestimate the number of fish present in streams, in which case greater care would be necessary to ensure the protection of riparian habitat. Since the maps for the master-planned communities were digitized, operational and source map error should also be considered: this may account for some of the instances where the layers do not align completely. The numerical findings do correlate with the loss of area observed through mapping. For this reason, the product of our analysis can be used as a good indicator of the approximate overlap between the proposed development and sensitive ecological habitat, but is not suitable for deriving highly precise and accurate measurements. As a tool for influencing policy, these maps could encourage a more detailed analysis of the ecological consequences of developing the master-planned communities, thereby determining effective methods to mitigate these impacts.

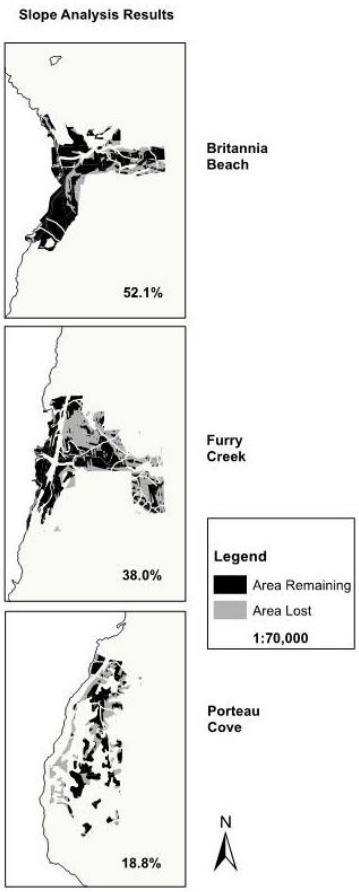

Figure 4. Illustrates the area lost due to unsuitable slope from the viable land determined by the environmental impact analysis. Percentages indicate the amount of developable land remaining overall after completion of the environmental impact and slope analyses. (Sources: Wilderness Committee; GeoBase; Statistics Canada.)

Slope Analysis

Table 3 (Appendix C) shows the developable area remaining after completion of the second stage of the analysis wherein slopes greater than or equal to 22° were removed from the community plans. These results are illustrated in Figure 4.

In Britannia Beach, 161.8 hectares—52.1% of the original proposed site—met the required conditions for development (low environmental impact and a slope of less than 22°). With respect to slope, most of

the eliminated area was located further inland from the coast where the gradients tended to be steeper. The distribution of the area that remained was such that a developer could maximize profit while integrating natural systems into the community.

Similar to Britannia Beach, much of the interior land in Furry Creek was found to be unsuitable for development; however, 38.0% of the land—most of which was located along the coast and main arterial streams—still had the capacity to support urbanization (keeping in mind the importance of maintaining the ecological integrity of the site). As Patrick Condon notes, urban areas often come into direct contention with streams since the former requires slope gradients that are commonly found near the latter (Condon 134). Thus, methods of ensuring the maintenance of ecological function are critical for producing a sustainable community that incorporates the natural framework into its armature—especially in communities located in areas of abundant biodiversity, such as these.

Porteau Cove was left with little viable land for development following the slope analysis, its area having been reduced from 155.9 hectares (determined through the environmental impact analysis) to 83.8 hectares—18.8% of the area originally proposed. To further frustrate development, the remaining area is distributed randomly throughout the site in non-contiguous parcels, providing few cohesive locations for the prospect of development. Although Porteau Cove is highly desirable real estate, it is likely that the site's profitability would be jeopardized by the lack of continuity among the 83.8 hectares of developable surface, particularly since the attainment of land assembly for joining neighbouring parcels would be complicated by the aforementioned conservation efforts. Further complications would arise from the current lack of publicly serviced infrastructure (roads, water coverage, and sewers), which the proponent would have to consider when calculating the costs of development. Ultimately, due to the presence of steep slopes and sensitive habitat, the site thereby offers a challenging—and potentially unprofitable—venture for developers. Hence, Porteau Cove might be better left as a recreational facility, thereby drawing annual revenue through tourism and allowing preservation of the area's biodiversity.

Despite the substantial reduction in hectares lost due to the incorporation of slope in the analysis, such measures are crucial to ensuring the mitigation of hazards resulting from slope destabilization. In addition to slope angle, development approaches must also take into account the impact on soil loss, erosion, excessive stormwater runoff, and landform changes (Land Use Planning & Policy 2). Because of landscape sensitivity, the use of site grading (cutting or filling) to achieve optimum slope levels may be limited. Grading and earthworks should therefore be minimized to maintain the existing topography and features of the site. This involves using staged grading, and the development of smaller pads and terraces, as opposed to the mass grading of an entire sloped parcel of land (Land Use Planning & Policy 12). Implementing these precautionary methods of topographical preservation, however, may cause additional constraints to the efficient allocation of land parcels for development, further impacting financial feasibility. To further complicate matters, the analysis does not take into account slope material, moisture content, groundwater condition, slope geometry, and vegetation cover; all of which must be assessed before final conclusions are made on slope stability for development (Land Use Planning & Policy 4). The conclusions drawn from the slope analysis for land suitability are, therefore, a basic starting point from which to assess development feasibility and hazard planning.

Methodology Analysis

Error may have been introduced through discrepancy in the scale of the datasets: although it is known that the digital elevation model had a scale of 1:50,000, the accuracy of the digitized maps of the communities was listed only as '10+' without context. Hence, the two layers may not overlay correctly, resulting in the incorrect location of indicated slopes; for that reason, the analysis provides only approximate statistics with regards to the locations of suitable slope for development and should not be used for development purposes. Rather, it is intended more so as an indicator of the feasibility of the proposed developments, and would require more analysis to produce a detailed quantitative summary to plot precise coordinates.

Conclusions

With the combination of land-use zoning and density bylaw amendments, Furry Creek and Britannia Beach have the potential to accommodate future population growth and development with low environmental impacts. Directions for further research involve analyzing feasible sites for watershed and environmental zoning within these two master-planned communities in order to provide buffers and preserve habitat. However, such schemes may complicate the financial viability of development, especially with regard to Porteau Cove (Concord Pacific). Left with 18.8% of the original proposed area, developing Porteau Cove is likely an unfeasible venture: with the remainder of the site consisting of non-contiguous parcels that would frustrate the implementation and continuity of infrastructure, development would likely be quite costly. Therefore, negotiations must be undertaken with the Squamish-Lillooet Regional District and other stakeholders in order to ensure a balance of the most sustainable and economically feasible path forward. With respect to the low-impact development options calculated through GIS analysis, future stakeholder negotiations should consider maintaining and enhancing the environmental reserve and/or recreational zoning. The former would require designing corridors to connect patches of habitat in order to preserve biodiversity. The latter would involve allocating recreational space where areas of significant contestation between development and environmental protection occur. By extending the trail system, a variety of environmental, economic, and social benefits could result, including: greater preservation of environmental areas as a buffer from development; an excellent real estate amenity to boost value for developers; and, lastly, the facilitation of pedestrian mobility and a connective tissue to establish a greater context for density and public health.

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Appendix A

Name of Data Layer	Organization	Source	Uses	Entity Type	Data Model
Furry Creek Master Plan	Wilderness Committee (WC)(ICIS/ Squamish Lillooet Regional District [SLRD])	Digitized	Residential planning	Areas	Vector
Porteau Cove Master Plan	WC (SLRD)	Digitized	Residential planning	Areas	Vector
Britannia Beach Master Plan	WC (SLRD)	Digitized	Residential planning	Areas	Vector
Conservancies (Parks and Protected Areas)	WC	Unknown	Buffered conservancies (50m)	Areas	Vector
Rare and endangered species' habitats	WC	Unknown	Sensitive habitat. Buffered habitats (50m).	Areas	Vector
Old-growth forests	WC	Unknown	Location of old-growth forests.	Areas	Vector
Spotted owl habitat	Wilderness Committee (BC Government)	Unknown	Spotted owl management areas in British Columbia.	Areas	Vector
Fish presence streams	Wilderness Committee (community mapping data)	Unknown	Buffered streams (15m for unknown fish presence; 30m for confirmed)	Lines	Vector
Ungulate wintering habitat	Wilderness Committee (GeoBC Gateway)	Unknown	Buffered ungulate wintering habitat (50m)	Areas	Vector
British Columbia base map (2006)	Statistics Canada	Unknown	Regional planning and the provision of services.	Areas	Vector
Elevation	GeoBase	1:50,000 DEMs (NTS 092g06 and 092g11)	Topographic analysis.	Surface	DEM

Table 1.Metadata.

Appendix B

	Original area (Ha)	Total area lost (Ha)	Total area remaining (Ha)	Total low-impact area remaining (%)
Britannia Beach	310.5	88.5	222.0	71.5
Furry Creek	376.5	110.3	266.1	70.7
Porteau Cove	446.7	290.8	155.9	34.9

Table 2.Environmental Impact Analysis Results.

Appendix C

	Low-environmental impact area (Ha)	Total area lost after slope analysis (Ha)	Total area remaining (<22°) (Ha)	Total area remaining of original area (%)
Britannia Beach	222.0	60.3	161.8	52.1
Furry Creek	266.1	123.1	143.0	38.0
Porteau Cove	155.9	72.1	83.8	18.8

Table 3: Slope Analysis Result

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Jeremy Elder is a fourth year Human Geography honours major. His interests lie in the intersections between 'nature' and society, and he is passionate about social and environmental justice. He enjoys dancing (but does it poorly) both alone and with friends, cycling around his hometown of Vancouver, and collecting books. One day he intends to read them. He is also deeply in love with food, the world, his friends and family; and has just entered into a serious relationship with theory. He loves to travel and wishes he could do more of it, and is excited for his eventual entry into grad school. 'Real life' is not on his agenda, but rather, his goal is to become a modern-day nomad who embraces the open road and serendipity.

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Kevin Chan is a fourth year human geographer with a passion for cities and the environment. After growing up mere blocks away from Still Creek and the Renfrew Ravine, he has become fascinated by the intersection between "urban" and "natural" spaces; where so much conventional wisdom about "human" identity and the meaning of "nature" can be questioned.

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Caitlin Sinclair has recently graduated from the University of British Columbia with a degree in Human Geography. With a background in critical social theory, Caitlin has spent much of her degree focusing on issues surrounding environmentalism and social justice. In the future, Caitlin hopes to continue her education in Geography.

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Lauren Punt is a student majoring in geography with a focus of environment and sustainability. Some of her favourite class subjects are geomorphology, glaciology, geographic information systems, asian studies, and political science. In the future she hopes to build her own environmental consulting firm to help companies practice sustainable development. Outside of school she spends time with friends and family, doing yoga, bike riding, swimming, skiing, photography, and travelling. Lauren was born in Vancouver British Columbia.

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