

# Appendix 1. Vancouver's Ecological Network

## Introduction

Biodiversity in urban landscapes depends on maintaining a network of connected natural areas anchored by larger patches such as Stanley Park and Pacific Spirit Regional Park. We call it the "Ecological Network" which reflects how it functions as a connected system. The analysis presented in this appendix describes the methods and results of a spatial analysis of the distribution of natural areas in the City of Vancouver and the potential connections between them. The analysis focuses on the terrestrial portion of the City of Vancouver, as well as Point Grey (Pacific Spirit Regional Park, UEL, Musqueam First Nation lands, and UBC), and the western edge of the City of Burnaby. Marine and intertidal areas were not included in the analysis because they support more mobile species which are not constrained by urban land use.

## Vegetation Mapping

Vegetation mapping was used to identify natural areas. Natural and semi-natural vegetation was mapped across the city using 2010 orthophotos. Vegetation is a useful indicator of the extent and condition of ecosystems, as well as their ecological value. Vegetation provides the structure which supports biodiversity and is a key indicator of ecological function. Vegetation can also be mapped consistently using the interpretation of air photos or orthophotos (rectified air photos). Vegetation polygon mapping was conducted in ArcView 3.2 and ArcGIS 10 at a scale of 1:3,500 with a minimum polygon size of approximately 0.05 ha.

A modified version of the U.S. National Vegetation Classification was used to classify all natural and semi-natural vegetation across the city. Table 2 provides a summary of vegetation classes, subclasses, and other data recorded for each polygon.

An important component of the mapping was an estimate of naturalness for each mapped polygon. Naturalness was estimated for each polygon on a scale of 1 to 5 with 1 being maintained

vegetation, and 5 being undisturbed, natural vegetation (see Table 3 for definitions).

To better assess naturalness, we measured vegetation composition and abundance in 199 plots (20 x 20 m) to better characterize the structure, and naturalness of vegetation communities across Vancouver (see Appendix 2 for more detail). This included natural areas such as forests in Stanley Park, but also developed or cultural vegetation in mowed turf areas and shrub thickets. Vegetation in heavily maintained urban gardens was not assessed.

## Ecological Network Analysis

A network of natural and semi-natural areas was identified using several GIS-based analyses: (1) identification of hubs and sites; (2) connectivity analyses using two methods; and (3) identification of biodiversity management areas.

**Hubs and Sites.** Large natural areas (called hubs and sites) were identified based on size and naturalness. Hubs are defined as natural areas greater than 10 ha in size comprised of vegetation of naturalness 3 or greater. Ten hectares was selected as the size threshold because it encompasses moderately large natural areas that can support populations of many native wildlife species, particularly if there are other natural areas nearby. Adjacent areas of naturalness 2 or greater that are contiguous with main hub area were also included. This acknowledged that hub boundaries will likely change over time as some areas are lost to development or other activities while others areas may become more natural through vegetation change. Hub boundaries were reviewed and minor modifications were made to eliminate small breaks or holes such as two-lane roads or utility rights-of-way and to remove linear "arms" on hubs which are subject to substantial edge effects.

Sites are smaller areas of natural or semi-natural vegetation (naturalness 3 or greater) between 0.1 and 10 ha in size. They are

also important to the functioning of the Ecological Network but are too small to be considered hubs. Many neighbourhood parks have areas of forest or shrub vegetation in this size range with significant ecological value.

**Connectivity Analysis - Corridors.** Potential connections between different units in the Ecological Network were assessed using a computer model to find the shortest, most natural route between hubs. Least-cost path analysis was used to determine the best ecological routes. Least-cost path analysis is a GIS method used to assess connectivity between habitat sites by examining the condition of the intervening landscape. A landscape impedance layer using Metro Vancouver's 2006 land use dataset and the road network was used to estimate the potential movement of wildlife through the landscape.

The analysis identified a range of pathways between hubs that offer the lowest cumulative resistance to movement by plant and animal species. The computer generated least-cost paths were revised to remove errors and merge or remove redundant or closely parallel paths. The term "potential corridor" is used to indicate that these are potential connections and can be adjusted in terms of width and location to best suit the local area and opportunities.

Potential corridors were divided into three classes: (1) functioning, (2) impaired, or (2) non-functioning according to their ability to assist wildlife in moving between hubs. This assessment was qualitative and reflected corridor length, width, fragmentation, and condition.

**Connectivity Analysis – Circuitscape.** Circuitscape is a computer model that applies the concepts of electrical circuit theory to ecological landscapes. Simulated electrical current finds the path of least resistance between different habitat nodes. Areas of good habitat will have low resistance to movement and areas of poor habitat will have higher resistance. Circuitscape analysis was used to

model the connectivity between large forest patches (the primary type of natural area in the city) within the Vancouver area. Circuitscape can also show “pinch points” where the movement of biodiversity is impeded, and where intervention to increase connectivity can be most effective.

**Biodiversity Zones.** The preliminary review of the connectivity analysis highlighted the lack of ecologically functioning connections between Vancouver’s remnant natural areas. For example, the corridor between Trout Lake to Stanley Park through the Eastern Core, Yaletown, and the West End is not in any way a potential route even for the most mobile of urban wildlife. These kinds of connections are an artifact of the analysis process in which the computer identifies the best path between each hub regardless of its ecological function or condition.

To identify important biodiversity areas that are more ecological relevant, we subjectively delineated “biodiversity zones” which encompassed hubs, as well as portions of the surrounding urban landscape. They also include smaller features such as the Renfrew Ravine Park and John Hendry Park (Trout Lake) which are too small or too disturbed to meet the criteria for hubs but nonetheless have important biodiversity values.

Biodiversity zones have three purposes: (1) to identify more practical units for conservation planning; (2) to identify priorities for improving ecological connections at the neighbourhood scale; and (3) to support the City’s land acquisition decisions.

## Results

**Vegetation Mapping.** A total of 3,628 vegetation polygons totalling 3,085 ha were mapped in the Vancouver-Point Grey study area. The average polygon size was 0.85 ha but ranged from 96 ha to 0.001 ha. It included:

- 1,674 ha (54%) of treed (forest) vegetation including 577 ha of mixed forest, 571 ha of evergreen forest, and 521 ha of deciduous forest.

- 1,203 ha (39%) of herbaceous vegetation of which 1,112 ha was grass dominated (mainly maintained turf). Ninety hectares of herbaceous wetland (marsh) vegetation was mapped mainly in the Musqueam Marsh.
- 142 ha of shrub vegetation (5%) including a large amount of blackberry thickets and other unmaintained shrub areas.

The average naturalness was 1.9 indicating that most of the vegetation is modified or semi-natural. The only areas with vegetation classified as 4 (mainly natural) or 5 (natural) were the older evergreen and mixed forests of Stanley Park, Pacific Spirit Regional Park, and Central Park in Burnaby (all classified as 4), and Musqueam Marsh (classified as 5).

**Hubs.** Eleven hubs totalling 499 ha were identified in the City of Vancouver although in some cases such as the eastern margin of Pacific Spirit Regional Park, not the entire hub was located in the City. Seven hubs were contained entirely within the city. Map X-X shows the location of hubs and Table 1-1 summarizes their size. Average hub size was 45.4 ha and varied from 291 ha to 11 ha. The largest hub was Stanley Park (291 ha) and accounted for 58% of the hub area in the City of Vancouver.

Ten of the eleven hubs accounting for 439 ha (88% of hub area) were contained in municipal parks and only the East Fraserlands (River District) hub is within private lands. This is different than City of Surrey and City of Richmond where only 24% and 13% of hubs were protected in municipal parks.

**Sites.** Seventy sites ranging in size from 0.1 to 8.5 ha were identified in the City of Vancouver. Total area was 109 ha and average size was 1.5 ha. Three hubs around 8 ha were identified in the Killarney neighbourhood: the south slope of Everett Crowley Park, the neighbourhood forests within Killarney, and Captain Cook Park. Other important sites for biodiversity are Renfrew Ravine Park (2 sites), Trout Lake in John Hendry Park, the Sanctuary Pond in Hastings Park, the forest adjacent to Prospect Point in Stanley Park,

Grandview Cut, and the Vanier Park – Burrard Bridge forest. Sites are shown in Map X-X.

**Table 1-1. Hubs located in the City of Vancouver.**

Name	Area (ha) <sup>1</sup>
Stanley Park	291
Stanley Park - East	14
Jericho Beach Park	37
Everett-Crowley Park	42
Fraserview Golf Course	42
Musqueam Park	22
New Brighton Park East	6 (25)
East Fraserlands	11
Pacific Spirit Regional Park (25 <sup>th</sup> Ave)	9 (481)
Pacific Spirit Regional Park (North Slope)	7 (247)
Shaughnessy Golf Course Escarpment	16 (247)
	<b>499 ha</b>

**Connectivity Analysis.** The corridor analysis identified 124.5 km of potential corridors in the study area including dense networks of corridors in Stanley Park and Pacific Spirit Regional Park (see Map X-X). Most (65.0 km; 65%) were classified as non-functioning, while 5.3 km (4%) were classified as impaired and 54.1 km (44%) were functioning. Many non-functioning corridors pass through urban neighbourhoods where fragmentation was very high. Many functioning corridors were within large natural areas.

The Circuitscape model provided a more realistic interpretation of the potential movement of biodiversity in Vancouver: it showed that most forest patches in the City of Vancouver are isolated and that potential corridors between them through urban neighbourhoods are poorly defined or non-existent. The Circuitscape results did not support the corridor analysis.

Circuitscape also highlighted the importance of distance and patch isolation for connectivity. Habitat patches that are close together,

<sup>1</sup> Values in parentheses show the total hub area including the portion outside the City of Vancouver.

such as the forest patches around Fraserview–Everett–Crowley–Killarney are better connected than patches that are more isolated.

Several important pinch points (denoted as white and red areas in the Circuitscape map) were identified where biodiversity movement may be impeded in localized areas: (1) Musqueam Park to Pacific Spirit Regional Park (through Marine Drive); (2) the south and north portions of Renfrew Ravine (through East 22<sup>nd</sup> Street); (3) Second Narrows Escarpment Forest (Montrose Park) to New Brighton Park (through Highway 1 corridor). These areas potentially have the greatest impact on the movement of forest-dependent wildlife.

**Biodiversity Management Areas.** We identified potential 12 biodiversity management areas in the Vancouver – Point Grey study area (see Table 1-2). All were built around the hubs and largest sites identified in the ecological network analysis. Table 1-1 lists the potential management areas and Map X-X shows their location. Almost half (1,296 ha) is located within or adjacent to Pacific Spirit Regional Park. Together with Stanley Park (423 ha) and Fraserview–Everett Crowley Park (331 ha), these three areas account for 77% of the biodiversity management areas in the city.

Many of them encompass developed neighbourhoods which will be important include as part of voluntary conservation planning (e.g., tree planting, pollinator gardens, etc).

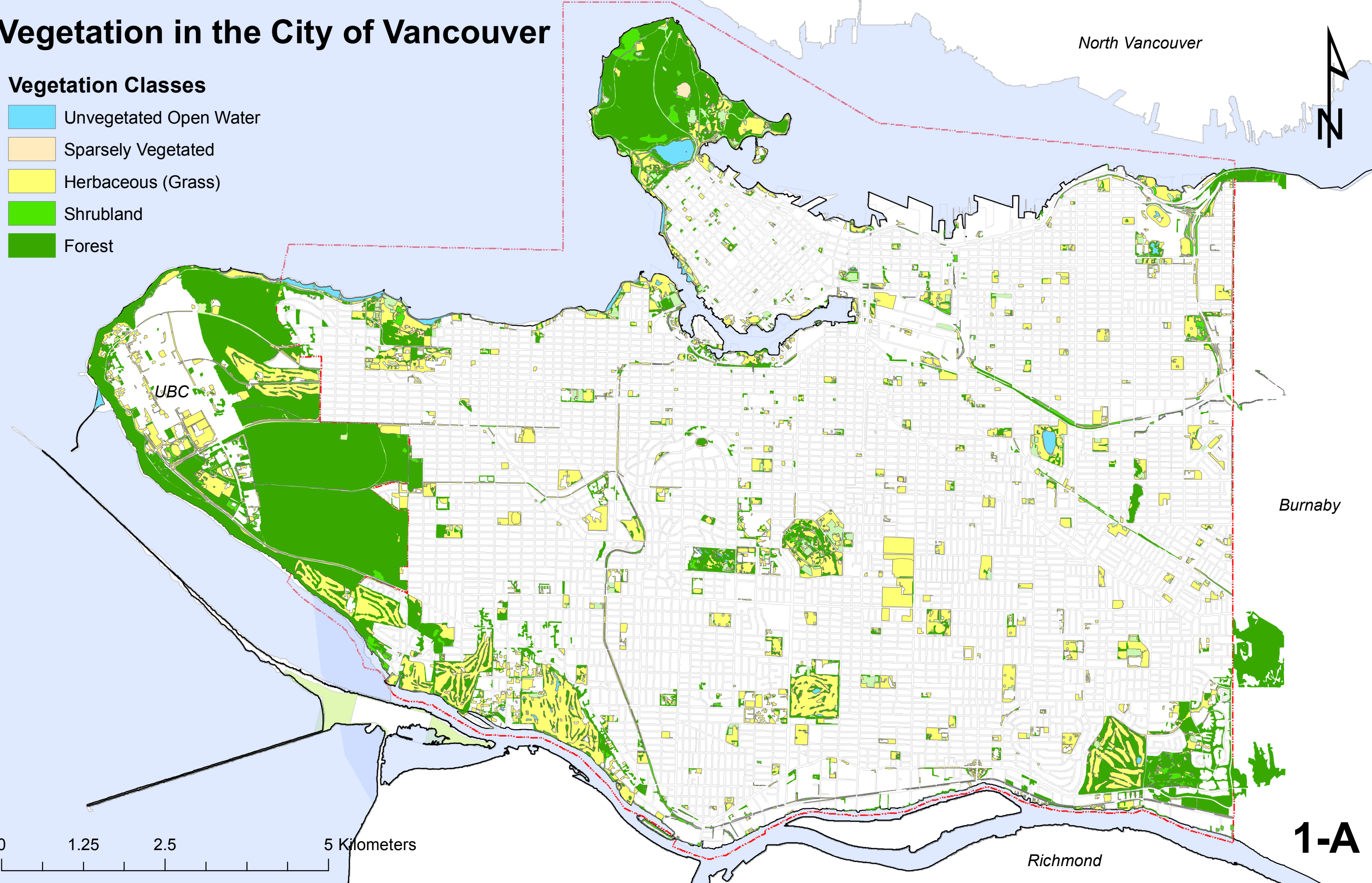
**Table 1-2. Proposed management areas in the City of Vancouver.**

No	Name	Total Area (ha)	Area in City (ha)
1	Stanley Park	423	398
2	Vanier Park	29	26
3	Jericho Park	95	84
4	Pacific Spirit RP	1,296	108
5	Musqueam Park	124	123
6	Southland Golf Course	115	111
7	VanDusen-QE Park	123	123
8	Langara Golf Course	54	54
9	Fraserview - Everett Crowley	331	262
10	Trout Lake	29	29
11	Renfrew Ravine Park	15	15
12	Second Narrow Escarpment	42	19
		<b>2,676 ha</b>	<b>1,351 ha</b>

# Vegetation in the City of Vancouver

## Vegetation Classes

- Unvegetated Open Water
- Sparsely Vegetated
- Herbaceous (Grass)
- Shrubland
- Forest



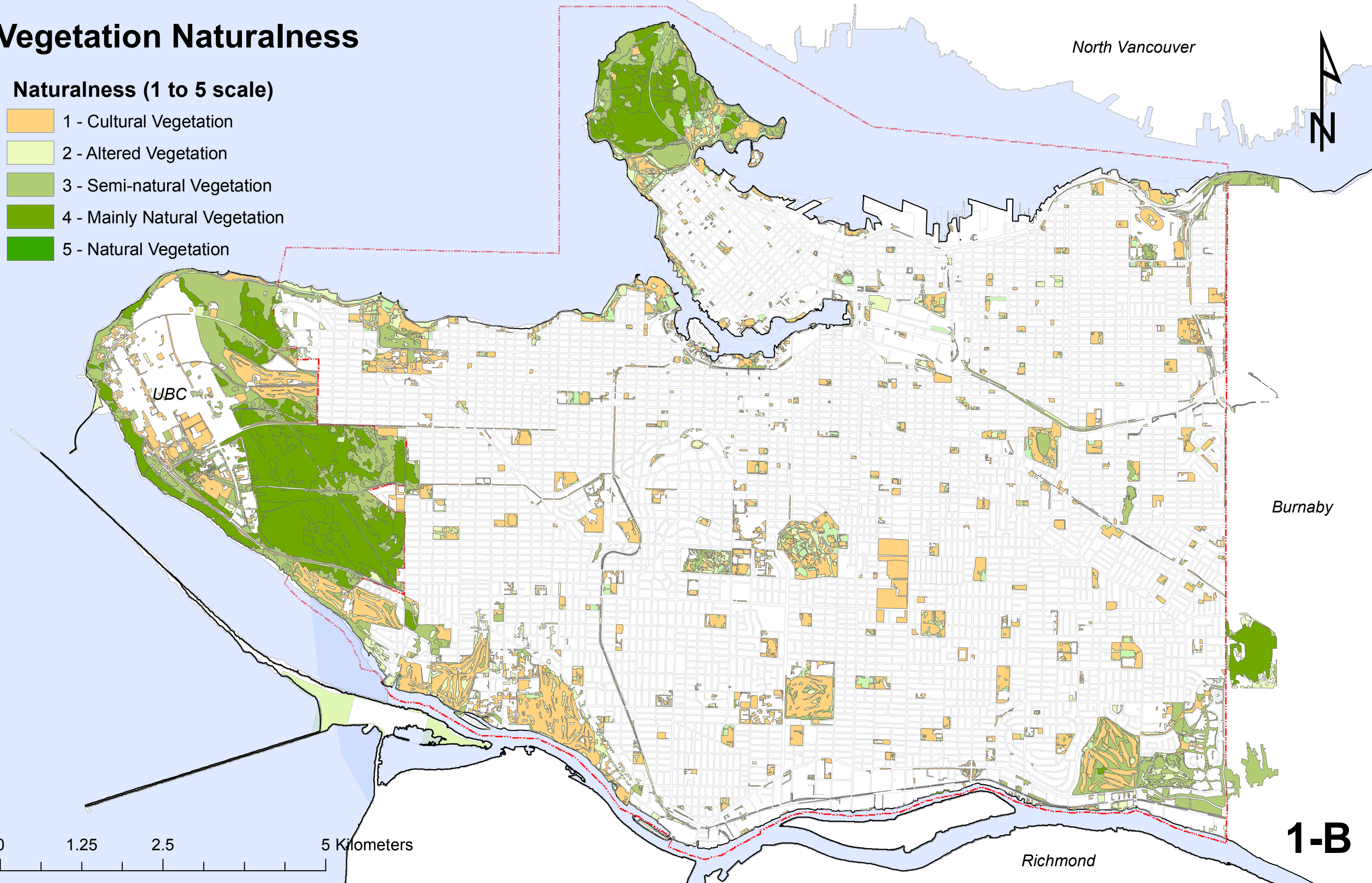
0 1.25 2.5 5 Kilometers

1-A

# Vegetation Naturalness

## Naturalness (1 to 5 scale)

- 1 - Cultural Vegetation
- 2 - Altered Vegetation
- 3 - Semi-natural Vegetation
- 4 - Mainly Natural Vegetation
- 5 - Natural Vegetation



North Vancouver

Burnaby

Richmond

UBC

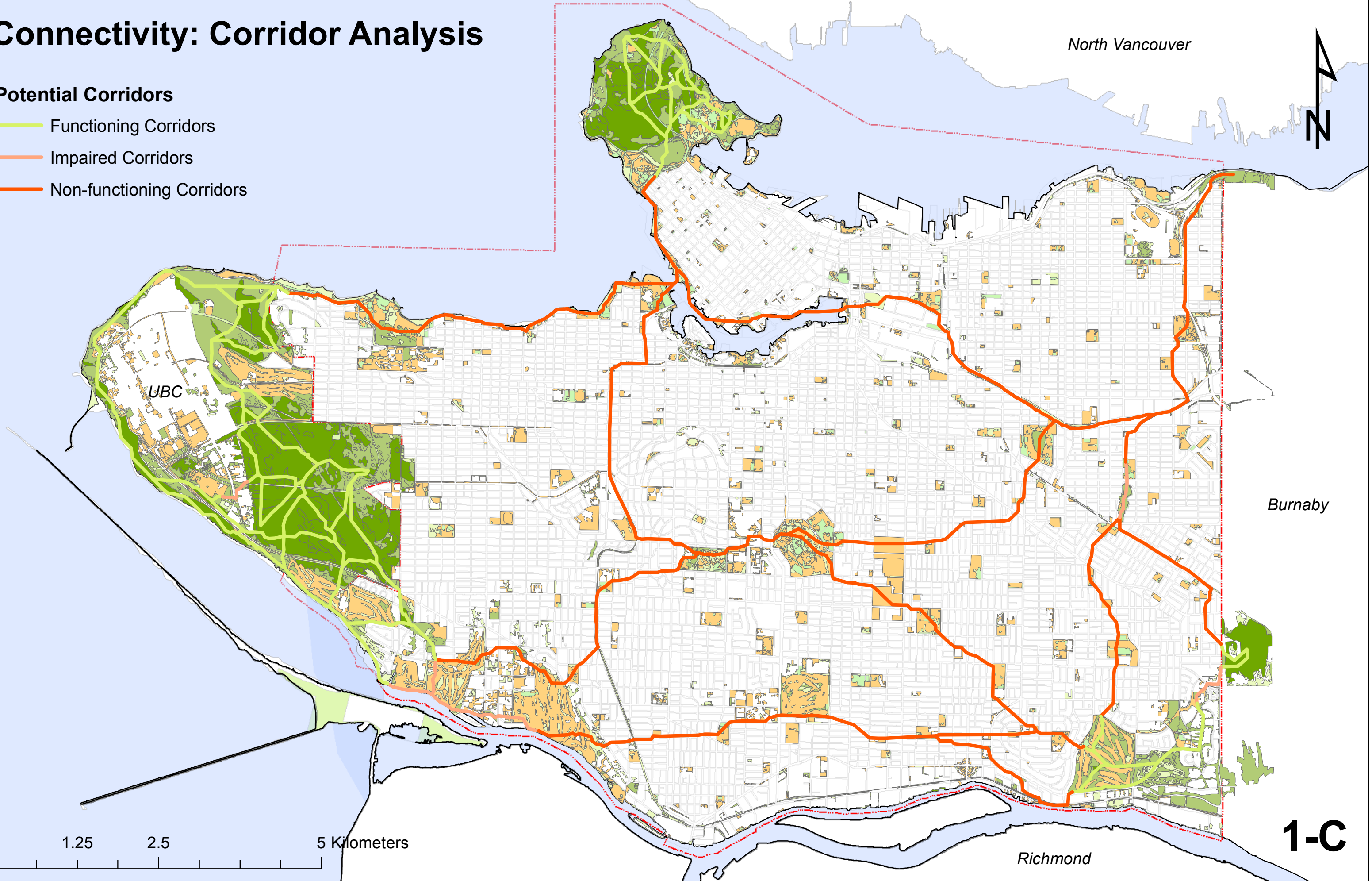
0 1.25 2.5 5 Kilometers

1-B

# Connectivity: Corridor Analysis



## Potential Corridors

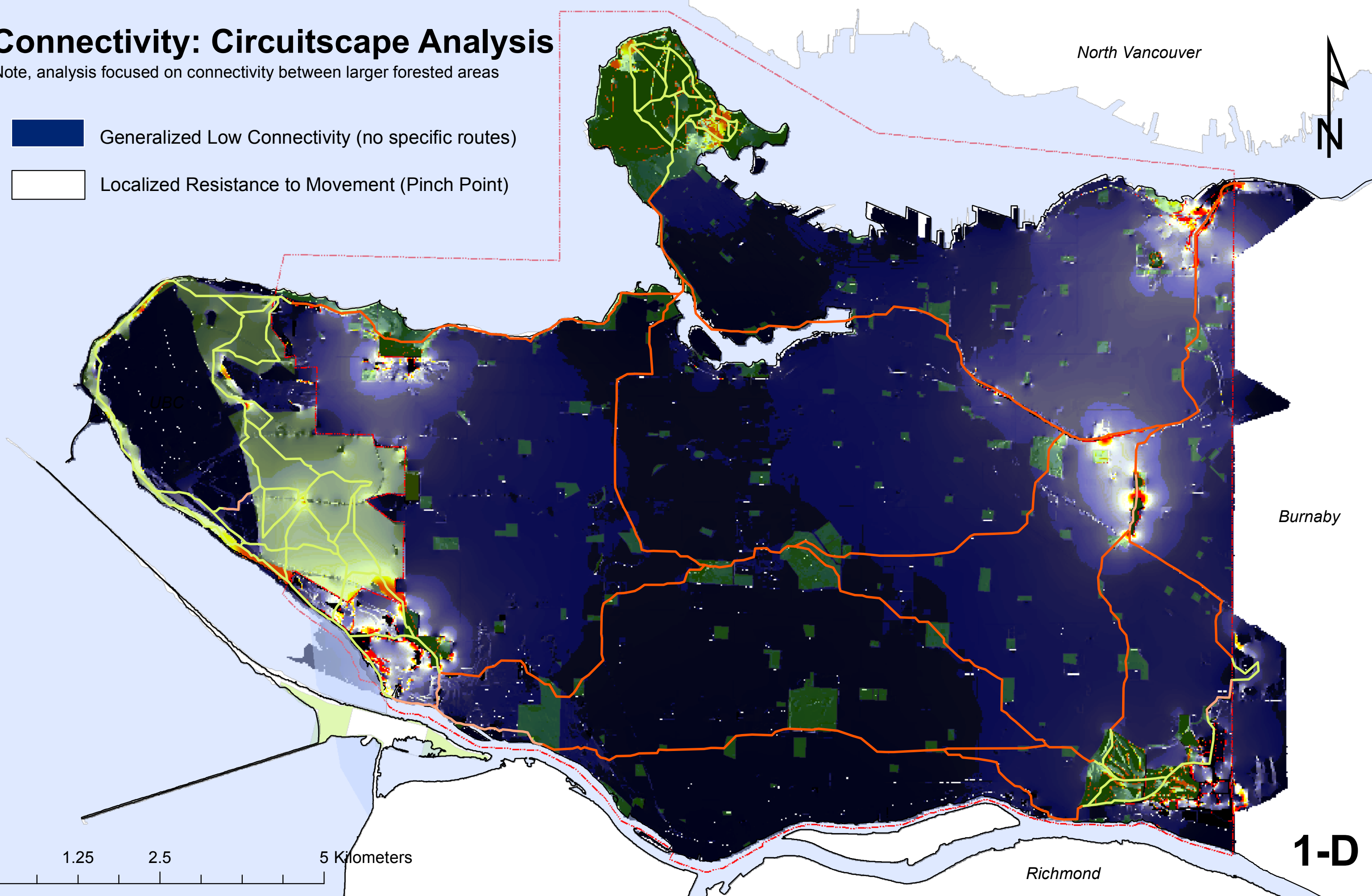
- Functioning Corridors
- Impaired Corridors
- Non-functioning Corridors



# Connectivity: Circuitscape Analysis

Note, analysis focused on connectivity between larger forested areas

-  Generalized Low Connectivity (no specific routes)
-  Localized Resistance to Movement (Pinch Point)



North Vancouver

Burnaby

Richmond

1-D

# Biodiversity Hotspots: Important Areas for Nature in the City of Vancouver

 Biodiversity Hotspots

24. Stanley Park Bluff

3. Stanley Park  
Shoreline

1. Stanley Park  
Forest

13. Beaver Lake

*District of North Vancouver*



26. Burnaby Shoal

9. Lost Lagoon

19. Second Narrows  
Escarpment

17. Sanctuary  
Pond

4. Spanish Bank

11. Kitsilano Shoreline

21. Vanier Forest

18. Jericho Wetland

8. Jericho Forest

27. Hinge Park & SEFC Island

23. Still Creek Corridor

*UBC*

10. Pacific Spirit  
Regional Park

14. Trout Lake

*City of  
Burnaby*

20. QE Park Forest

12. Renfrew  
Ravine

7. Musqueam Park  
& Musqueam Creek

15. VanDusen  
Forest

6. Musqueam Marsh

22. Southlands Foreshore

25. Langara Pond

28. Avalon Pond

5. Everett Crowley &  
Captain Cook Parks

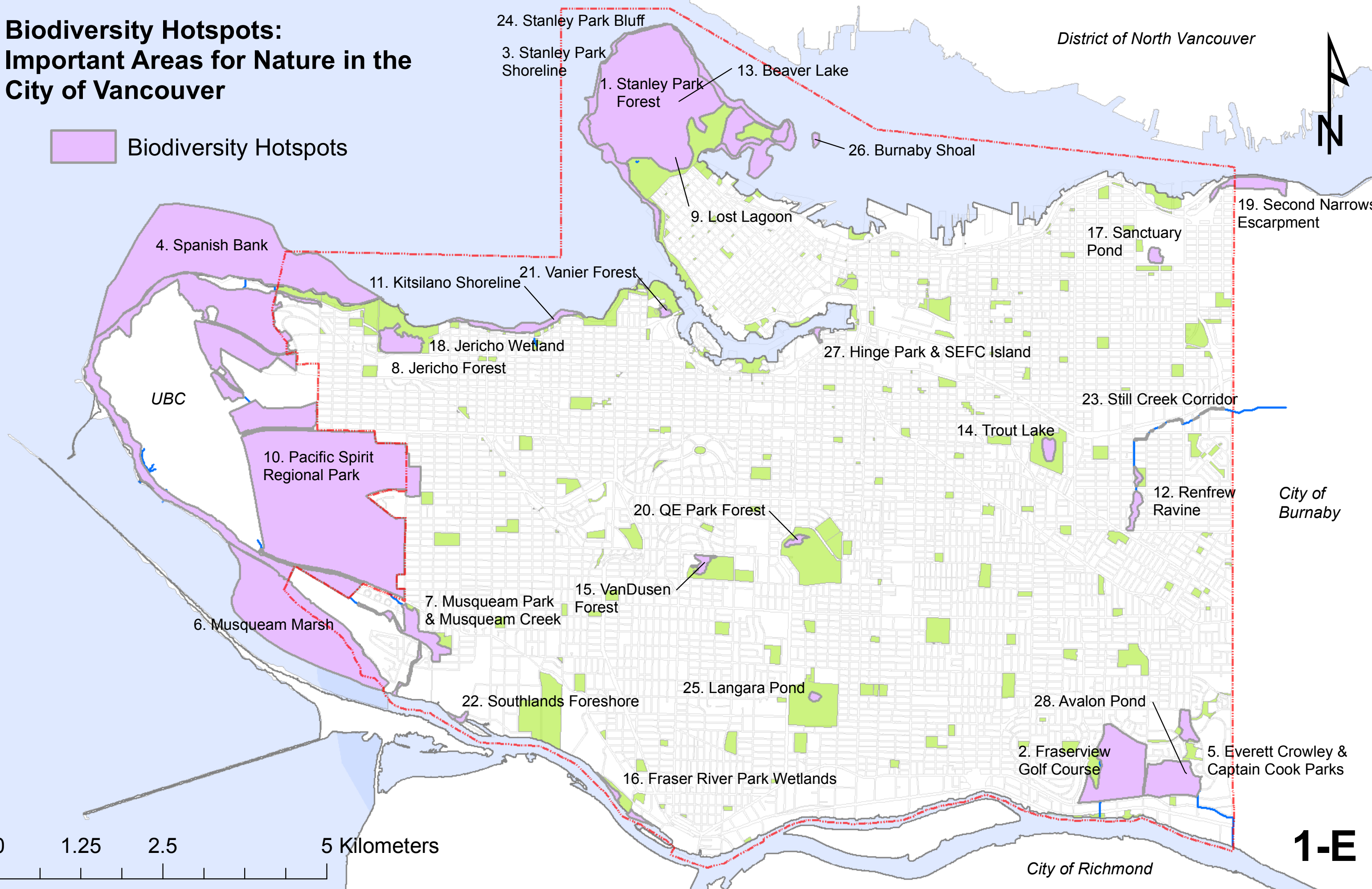
0 1.25 2.5 5 Kilometers

16. Fraser River Park Wetlands

2. Fraserview  
Golf Course

*City of Richmond*

**1-E**





# Biodiversity Management Areas

Management areas reflect practical, high priority areas for biodiversity enhancement such as enhanced tree planting and other habitat restoration. Some sites are large enough to function as important habitat in isolation of other areas (e.g., John Hendry (Trout Lake) Park, Langara Golf Course), while others build on enhanced connectivity (e.g., VanDusen Garden to Queen Elizabeth Park).

