

3.0 THE CONSERVATION AREA ENVIRONMENT

This section provides an overview of the conservation area environment and regional setting. Issues and information presented in this section have been identified through a review of existing reports and information, through site visits and field work, and from discussions with the City of Burnaby, other government agencies, the public and stakeholders. More detailed recommendations for addressing these issues are presented in Section 6.0.

3.1 Climate and Microclimate

Burnaby Mountain Conservation Area falls within the Coastal Western Hemlock biogeoclimatic zone characterized by abundant rainfall and mild temperatures. Locally, Burnaby Mountain is influenced by cyclonic weather systems originating over the Pacific Ocean. Mean annual precipitation is about 1270mm on the mountain footslopes. This increases to about 2200mm over the eastern prominence, which is also the highest point. Most precipitation occurs during winter in the form of rain. In summer, long dry periods may occur. During these periods many of the smaller local streams and drainage channels dry up. However, after heavy rains, these same streams may overflow to produce local sheet runoff. On the steep north and eastern slopes, runoff can be sufficiently great to pick up loose surface material such as boulders and logs to create small debris flows.

Like precipitation, winds originate over the Pacific Ocean and generally strike the south and southeastern slopes of Burnaby Mountain. As a result of these wind patterns, the southern slopes receive more precipitation and are therefore the wettest on the mountain. Winds blowing up the southern slopes can also compress layers of air to produce jetting over the top of the escarpment on the north side of the mountain.

In the summer, sunlight warms forest air for longer on southwest slopes, making these the warmest on the mountain. The northern and northeastern slopes receive little direct sunlight and are therefore cooler and damper. During colder than usual winters, the steep ravines of the northern escarpment can become covered in ice. A heavy winter's snowfall mostly thaws by the end of February on southwestern mountain slopes, whereas on northeastern slopes, snow patches can remain until the end of March. A more detailed overview of the climate of Burnaby Mountain can be found in Crampton 1990.

3.2 Terrain

3.2.1 Geology and Soils

Burnaby Mountain is the highest point in the City of Burnaby at about 360m (1200 feet) above sea level (Figure 3-1). The mountain is underlain by layers of sandstone, shale, conglomerate and siltstone that together form the Kitsilano and Burrard

Formation (Figure 3-2) (Armstrong 1990, REM 1996). Hard conglomerates cap the mountain and crop out along the middle escarpment to form cliff-sided ravines best seen below Centennial Pavilion. Large boulders or "erratics" which have been deposited by receding glaciers approximately 15,000 years ago can also be found on the mountain.

Sedimentary rocks were deposited by ancient rivers during the Eocene Period about 39 to 45 million years ago. Erosion has steadily worn each successive layer since that time. Much of this erosion was caused by an uplift of the Coast Mountains about 5 million years ago which also inclined the sediments southwards. This resulted in a moderate to steep north facing escarpment and a more gentle south facing dip slope. The advance and retreat of various glaciers during the past 2 million years has also removed many layers of sediment. During this period, large blocks of sedimentary material slumped downhill leaving the steep north side of the mountain unstable. Construction of the railway and Barnet Highway along the base of the hill caused new slumps in the unstable deposits (Crampton 1986). Although the north slopes are generally considered to be in a state of equilibrium under current conditions, some movements are occurring at the toe along the length of the mountain. Slope movements or failures during the past 50 years are primarily associated with human-made excavations, overloading and concentration of groundwater flows between the toe of the mountain and Burrard Inlet.

Soils on the mountain are mostly of glacial origin. Sandstones and conglomerates have weathered under the cool and wet conditions of the mountain to yield well drained and very acidic podzolic soils along much of the conservation area's upper elevations (Cook 1957, Crampton 1990). These soils are typically formed under the canopy of coniferous forests in humid coastal climates. Gleysolic soils (similar to Podzols only less acidic) can be found along the gentler footslopes of the mountain where more water accumulates. Soils are shallow on the steeper northern slopes and on the mountain plateau where construction activity has scraped away the original soils. South facing slopes below the 335m elevation are mantled by a thin organic layer. Topsoils are generally underlain by silty sands and gravel. Very acid and nutrient-poor soils occur locally elsewhere on the mountain plateau. On lower slopes the soils are near neutral in acidity.

Elevation, soils and topography, combined with climate, play an important role in determining the plant and habitat types found on the mountain. In addition, these factors combine to influence the location of viewpoints, trails and other recreation amenities. For example, the moderate to steep slopes found on the north side of the mountain have limited recreational use, which has created a block of relatively undisturbed habitat.

3.2.2 Soil Erosion

Human activity has caused erosion to occur along trails and watercourses. This has been noted on steeper trails, and on gentler trails near creek beds. Some of this trail damage is attributed to mountain bikes particularly in the south east section of the



Figure 3-1: Terrain map of the Burnaby Mountain Conservation Area

mountain and specifically where bike trails have crossed or paralleled streams. Pedestrians also cause erosion to occur on steeper slopes when they veer from designated trails, hike too close to watercourses, or use trails in very wet conditions. Factors other than recreational use may also contribute to the erosion of steeper slopes, for example, construction or maintenance activities that involve the clearing of vegetation can make slopes more prone to above-surface water flows which can lead to mudslides. Increased runoff caused by disturbances to existing drainage patterns is another factor that may contribute to erosion.

3.2.3 Slope Stability

Development of trails, facilities and access points on the north slope of Burnaby Mountain will be influenced by terrain conditions and inherent slope instability (e.g., debris flows, localized slides, ground creep). The north side of the mountain has undergone considerable sliding in the past (Armstrong 1957, Cook 1957). Although these slopes are generally considered to be in a state of equilibrium under current conditions, some movements are occurring at the toe along the length of the mountain. Areas that have historically undergone sliding, even where they currently appear stable, may experience renewed movement triggered by: increased loading (i.e., construction activities); increased water content; excavation; undermining the toe of the slope; or earth vibrations (either natural or human-made). Past studies of the geotechnical stability of the north slope are found in Armstrong 1957, Cook 1957, Delcan 1994a and 1994b, and Gartner Lee 1999.

The most recent (Gartner Lee 1999) indicated that although there is a possibility that a massive deep-seated bedrock slump could occur along the slope above the site of the former target ranges, the likelihood is remote and would most likely be associated with an earthquake of considerable magnitude. However, much smaller land and debris slides do occur and are likely to continue to occur along steeper slopes on the north side of Burnaby Mountain. Based on their assessment of the former target range sites and on evidence of frequent debris flows above the ranges, they recommended that use of this site be restricted to day-use activities and that trails be located away from the base of very steep slopes.

The same geotechnical hazards do not exist on the southern slope. However, trail development and routing here should consider potential effects on surface and sub-surface drainage patterns. Much of the southern slope is characterized by ephemeral and permanent watercourses as well as sub-surface water flows. Disturbance to these soils could result in even wetter conditions that could have implications on local hydrology, vegetation, and slope stability.

3.2.4 Public Safety Issues

Terrain on most of the north side of Burnaby Mountain is very steep and soils are unstable with the exception of the lowest elevations. The steepest areas occur below Centennial Pavilion and the Trans-Canada Trail route (Trails 'G' and 'F') and above the former target range facilities and the hydro right-of-way (Trail 'M'). In

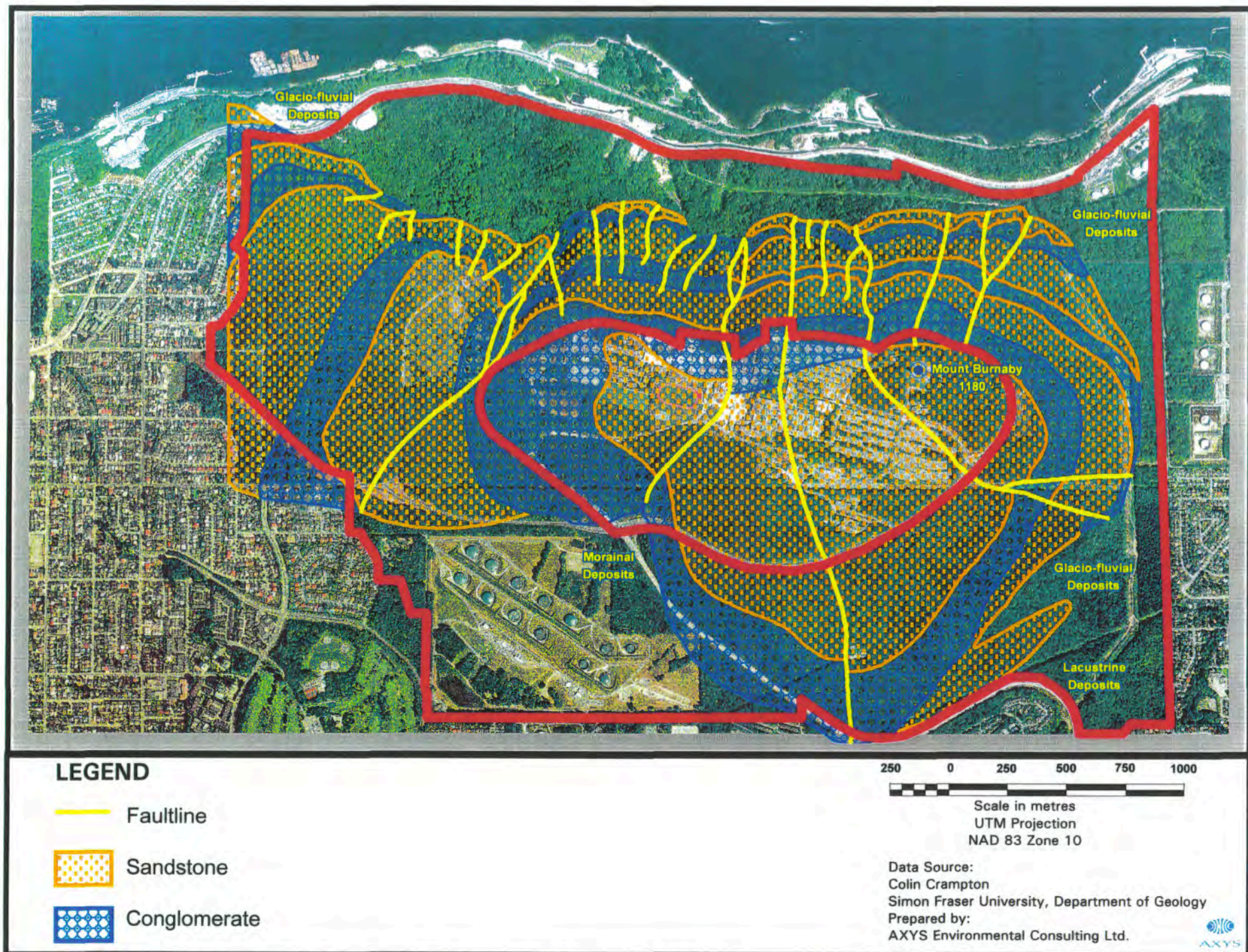


Figure 3-2: Geology of the Burnaby Mountain Conservation Area

some areas, climbing even a few feet upslope causes soils to slide, disturbing vegetation and making climbing hazardous. Additionally, landslides or mudslides have occurred in the past, affecting the entire upper and lower elevations. When combined with dense vegetation and difficult access, this area poses a potential safety risk for visitors. Visitor use of this area is relatively low due to a lack of formalized trails and the presence of three outdoor target ranges (which have since been decommissioned). However, use may increase if better access is provided. Other parts of the mountain do not pose the same public safety risks due to gentler slopes and easier trail access.

3.3 Vegetation

One of the most important biophysical resource management issues for Burnaby Mountain Conservation Area will be the retention and enhancement of forested areas. Forest conservation issues include: trampling of vegetation near trails; loss of vegetation in riparian areas due to erosion or human use; loss of vegetation through direct removal by visitors; presence of dwarf mistletoe and witches broom throughout the study area; protection of areas that may contain rare plant species; and preservation of vegetation for use by wildlife. These issues are addressed in the following sections. The timely preparation of a separate Vegetation Management Plan will be important in setting management direction to ensure long-term health of the forest.

3.3.1 Vegetation Species

Burnaby Mountain is found in the Coastal Western Hemlock Biogeoclimatic Zone, and is in the Dry Maritime Subzone of this unit (CWHdm). While this zone is typically composed of forests dominated by western hemlock and other coniferous species, logging on the mountain around the turn of the century and again in the 1940s altered the structure and composition of the forest. The original forest was composed of large western red cedar, western hemlock and Douglas fir trees. Today the forest is dominated by deciduous species in their early successional stage, although some large stands of conifers remain on the south and steep north slopes including patches of large remnant fir trees. Previous vegetation studies for Burnaby Mountain include: Sigma Resource Consultants 1979, Borkwood 1980, Crampton 1990, AXYS 1994, Delcan 1994a and 1994b, and New Pacific Ventures 1998.

3.3.1.1 Common Plants Found on Burnaby Mountain

On Burnaby Mountain, topography, elevation, aspect and proximity to disturbed or modified areas contribute to the diversity of vegetation species. The present-day forest cover is typical of other similar areas in the Lower Mainland which were subject to early logging practices. Major tree species include: red alder, bigleaf maple, western hemlock, western red cedar, Douglas-fir, vine maple, western dogwood, and paper birch. Other species such as sitka spruce and black cottonwood are also present in some areas. Much of the conservation area is

occupied by a deciduous overstorey dominated by red alder, but in some areas there is a considerable proportion of bigleaf maple, particularly on drier sites and often with Douglas-fir. A complete list of vegetation species recorded for Burnaby Mountain is presented in Appendix G.

Trees on the steep northern and eastern slopes survived early logging and in places Douglas-fir seedlings have grown into ninety-year-old coniferous stands. Conditions on the north side of the mountain are darker and cooler and some stands exhibit characteristics typical of coastal temperate rainforests (e.g., hanging mosses). The more gentle southern slopes were more damaged by the intensity of logging and burning. Alder and maple now dominate these southern forests although there is a relatively large conifer-dominated stand south of the SFU Ring Road on the southeastern slope. The stand is comprised mainly of hemlock and cedar with a few larger specimens of Douglas-fir.

Shrubs and low trees such as vine maple, red elderberry, salmonberry and thimbleberry are present, while ground covers are composed of ferns (predominately sword fern) and mosses. An understorey of salmonberry is present in most of the sites characterized by an overstorey of red alder. This is a reflection of soil conditions and the higher penetration of sunlight into the understorey. Along watercourses, where soil conditions are moister, communities are characterized by vine maple, salmonberry, devil's club and ferns. In drier areas, species such as salal and Oregon grape have developed. A thick cover of salmonberry and/or blackberry can be found on disturbed sites and rights-of-way. Other species such as thimbleberry, red elderberry, bracken fern and regenerating bigleaf maple and western red cedar are encountered in some disturbed areas. Where shrubs are less dense, a more developed herb layer may be found. Herbaceous species found on the mountain include, among many others: ferns, foamflower, bleeding heart, and western trillium. Modified, open sites within the study area include the grassy areas around the Centennial Pavillion, the Trans-Mountain tank farm facilities and the former target range facilities.

3.3.1.2 Rare Plants

None of the plant species recorded for Burnaby Mountain are listed on provincial or federal lists of rare species. Rare plants generally occur on sites characterized by relatively moist soils that are also high in nutrients, and are best observed during the spring. Some sites on Burnaby Mountain Conservation Area contain soils capable of supporting rare plants, e.g., the lower north and lower south-eastern parts of the mountain. Although inventories of the mountain did not uncover any rare or endangered plant species, western trillium occurs throughout the lower slope of Burnaby Mountain (particularly on the western side). This species is protected from removal or destruction under the Dogwood, Rhododendron and Trillium Protection Act¹.

¹ Persons lawfully engaged in carrying out a public work are exempted from the prohibition.

A number of provincially-rare species occur in the vicinity of Burnaby Mountain and may potentially occur in the conservation area. These are listed in Table 3-1.

Table 3-1. List of Provincially Rare and Endangered Plant Species Known or Expected to occur in the Vicinity of Burnaby Mountain

| <i>Species (common name)</i> | <i>Provincial Designation¹</i> | <i>Known to occur in the vicinity of Burnaby Mountain</i> | <i>Expected to occur on Burnaby Mountain</i> |
|--------------------------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------|
| <i>Apocynum sibiricum saligrum</i> (Clasping-leaved dogbane) | Blue | X | X |
| <i>Callitriche anceps</i> (Two-edged water starwort) | Blue | X | X |
| <i>Carex scoparia</i> (Pointed Broom sedge) | Red | X | X |
| <i>Chenopodium leptophyllum oblongifolium</i> (Narrow-leaved goosefoot) | Red | X | X |
| <i>Oblongifolium elatine rubella</i> (Three-flowered waterwort) | Blue | X | X |
| <i>Eleocharis parvula</i> (Small spike-rush) | Blue | X | |
| <i>Epilobium leptocarpum</i> (Small-flowered willowherb) | Blue | X | X |
| <i>Impatiens capensis</i> (Spotted touch-me-not) | Blue | X | X |
| <i>Leersia orzoides</i> (Rice Cutgrass) | Blue | X | X |
| <i>Liacea scilloides</i> (Flowering Quillwort) | Blue | | X |
| <i>Lindernia anagallidea</i> (False-pimpernel) | Red | X | X |
| <i>Lupinus rivularis</i> (Stream-bank lupine) | Red | X | X |
| <i>Myriophyllum ussuriense</i> (Ussurian water-milfoil) | Blue | X | |
| <i>Polygonum punctatum</i> (Dotted smartweed) | Blue | X | |
| <i>Salix sessilifolia</i> (Sessile-leaved sandbar willow) | Blue | X | |
| <i>Wolffia borealis</i> (Water-meal) | Red | | X |

Source: B.C. Conservation Data Centre (CDC 1998)

Notes:

- 1 Provincial Designation from MELP and Conservation Data Centre
 - Red List: indigenous species considered to be extirpated, endangered, or threatened.
 - Blue List: indigenous species considered to be vulnerable in British Columbia.
- 2 There are no known federally-listed plant species (COSEWIC) on Burnaby Mountain.

3.3.1.3 Exotic and Invasive Species

Disturbed areas such as rights-of-way are often invaded by invasive species such as broom, thistle and blackberry. On Burnaby Mountain, many disturbed areas associated with rights-of-way are dominated by a thick cover of salmonberry and/or Himalayan blackberry (an introduced species). Species such as thimbleberry, red elderberry, bracken fern and regenerating big-leaf maple and western red cedar are also encountered in disturbed areas. The heavy cover of invasive species on rights-of-way may be limiting the use of these sites for birds or other species that forage along clearings and edges. There are documented occurrences of exotic plants such as Japanese knotweed and a European species of jewelweed. The population of these species, and their effects on native species, is uncertain. Their presence was not recorded during recent inventories although they are known to exist in the region. No standard practices for dealing with these particular species are known but Burnaby may consider monitoring their presence if their locations can be documented.

3.3.2 Vegetation Communities

The mountain is comprised of nine unique vegetation communities and a number of sub-communities which are summarized in Table 3-2 and illustrated on Figure 3-3 (See Table 3-3 for vegetation codes used in Figure 3-3). Each vegetation community is defined by the following parameters:

- Tree species: dominant and co-dominant species found within the main and upper canopy tree strata (20m in height or above);
- Understorey species: dominant and co-dominant species found within the understorey tree strata (10m to 20m in height);
- Major shrubs and herbs: main species found within the shrub and herbaceous layers (0m to 10m); and
- Soil conditions: an estimate of soil moisture and soil nutrients typical of the site.

On much of the mountain the overstorey is dominated by red alder and bigleaf maple. In various sections of the north and southeast slopes, conifers such as western hemlock, western red cedar and Douglas-fir also make up part of the overstorey or may be found in the understorey or herbaceous layers to indicate regeneration. However, in many areas of the mountain coniferous species are nearly absent.

No provincially rare or unique species or ecosystems were observed during field surveys. At the local level (i.e., within the conservation area) however, there are a number of relatively unique plant communities. Two vegetation communities found near the lower western slopes of Burnaby Mountain are unique to the conservation area. These are a mixed hemlock-cedar stand with alder and maple as sub-dominant species; and a cedar-sitka spruce stand. A third community found here (big-leaf maple with cedar and hemlock as sub-dominant) was only identified in one other part of the conservation area. The lower north-western slope between the Harry Jerome Sports Centre and the former target ranges, and a small area immediately

Table 3-2. Vegetation Communities of Burnaby Mountain Conservation Area

| # | Tree Canopy Cover ¹ | Understorey Trees | Major Shrubs | Major Herbs | Soil Conditions ² |
|----|-----------------------------------------------------------|--------------------------------------------|--------------------------------------------------------|---------------------------------------------|------------------------------|
| 1 | Western Hemlock (Douglas fir) | Vine maple/ Red huckleberry | Salal | Brackenfern | Dry/ Poor-med. |
| 2a | Red alder/bigleaf maple | | Salmonberry | Swordfern | Fresh-moist/ rich |
| 2b | Red alder/bigleaf maple (Douglas fir) | Vine maple | Salmonberry | Swordfern | Dry-fresh/ Med.-rich |
| 2c | Red alder/bigleaf maple (red cedar) | Vine maple | Salmonberry | Ladyfern | Fresh-moist/ med.-rich |
| 2d | Red alder/bigleaf maple (hemlock) | Vine maple | Elderberry/ salmonberry | Swordfern | Dry-moist/med. |
| 2e | Red alder/bigleaf maple (hemlock) (red cedar) | | Salmonberry | Sword fern | Fresh-moist/ med.-rich |
| 2f | Red alder/bigleaf maple (hemlock) (Douglas fir) | Red cedar/ hemlock | Salmonberry | Ladyfern/ Swordfern | Dry-fresh/med. |
| 2g | Western hemlock/ red cedar (red alder) (bigleaf maple) | | Red huckleberry/ salmonberry | Swordfern | Moist/med. |
| 3 | Red alder | Red alder/ Bigleaf maple/ Vine maple | Elderberry/ Red huckleberry/ trailing blackberry | Ladyfern | Dry-moist/ Med.-rich |
| 4 | Western red cedar (sitka spruce) | Vine maple | Swordfern | Western hemlock | Dry-fresh/rich |
| 5 | Western hemlock | Red huckleberry/ Salmonberry | Bunchberry | Moss | Dry-fresh/poor-med. |
| 6 | Red alder (black cottonwood) | Red cedar/ hemlock | Salmonberry | Foamflower/s wordfern/ Spiny woodfern | Fresh/med.-rich |
| 7 | Bigleaf maple (red cedar/hemlock) | Vine maple | Salmonberry | Swordfern | Fresh-moist/ med.-rich |
| 8 | Grassland | N/A | N/A | Various grasses | Varied |
| 9 | Developed | N/A | N/A | N/A | Varied |

Notes:

- 1 When more than one species is listed, the species which make up the greatest percent of the canopy cover are listed first. Species in parentheses make up less than 15% of canopy cover.
- 2 Soil moisture and soil nutrients were not measured directly, but were inferred from the typical soil habitats of indicator species found in the polygons.

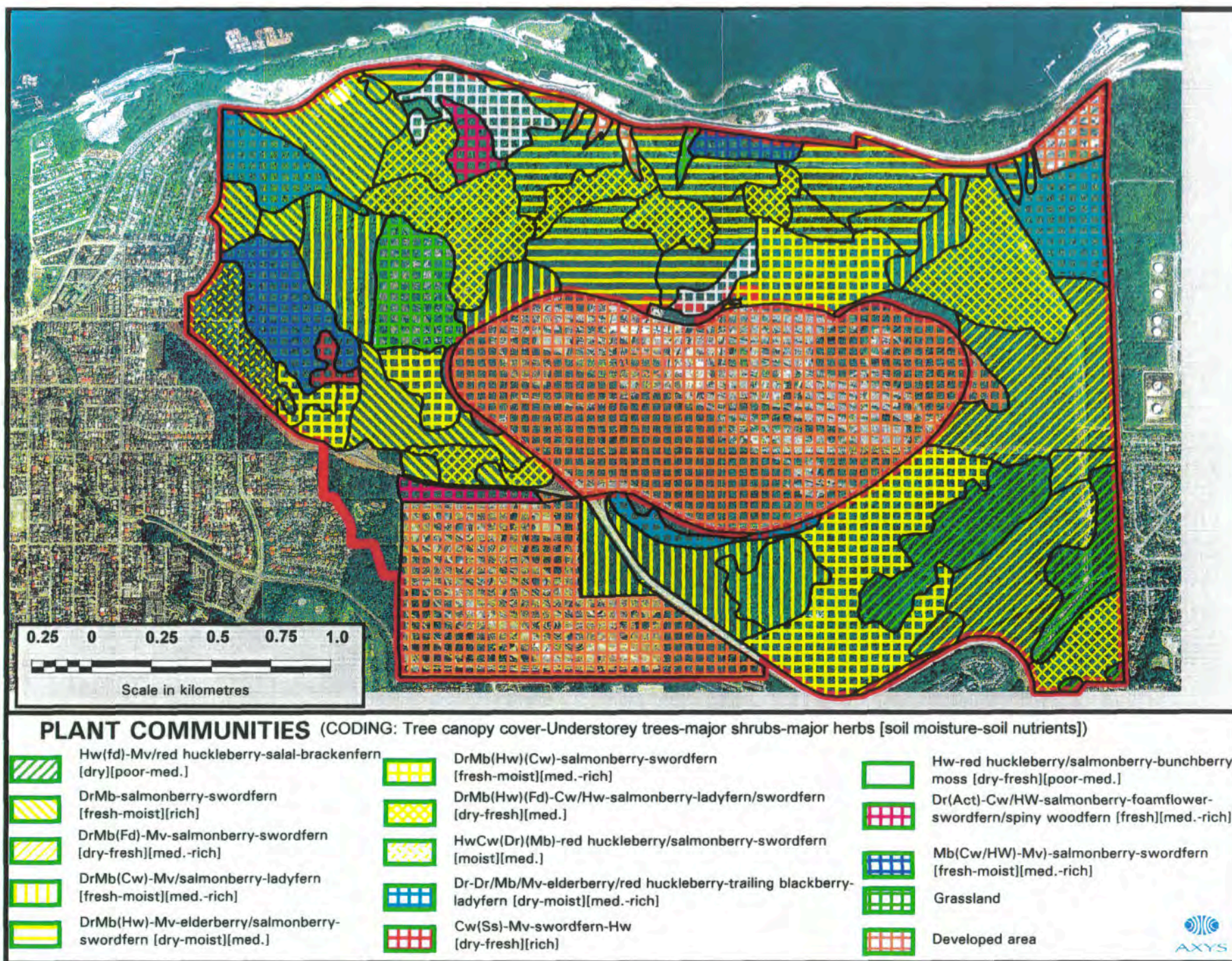


Figure 3-3: Vegetation Communities within the Burnaby Mountain Conservation Area

Table 3-3. Standard Codes for Vegetation Species

| <i>Species Codes</i> | <i>Latin Name</i> | <i>Common Name</i> |
|----------------------|------------------------------|--------------------------|
| Trees | | |
| CW | <i>Thuja plicata</i> | Western red cedar |
| FDC | <i>Pseudotsuga menziesii</i> | Douglas fir (coast) |
| HW | <i>Tsuga heterophylla</i> | Western hemlock |
| MB | <i>Acer macrophyllum</i> | Bigleaf maple |
| DR | <i>Alnus rubra</i> | Red alder |
| SS | <i>Picea sitchensis</i> | Sitka spruce |
| MV | <i>Acer circinatum</i> | Vine maple |
| ACT | <i>Populus trichocarpa</i> | Black cottonwood |
| Shrubs | | |
| RUBUSPE | <i>Rubus spectabilis</i> | Salmonberry |
| SAMBRAC | <i>Sambuca racemosa</i> | Elderberry |
| RUBUDIS | <i>Rubus discolor</i> | Himalayan blackberry |
| RUBUURS | <i>Rubus ursinus</i> | Trailing blackberry |
| OPLOHOR | <i>Oplopanax horridus</i> | Devil's club |
| OEMLCER | <i>Oemlaria cerasiformis</i> | Indian plum |
| VACCPAR | <i>Vaccinium parviflora</i> | Red huckleberry |
| GAULSHA | <i>Gaultheria shallon</i> | Salal |
| MAHONER | <i>Mahonia nervosa</i> | Dull Oregon-grape |
| Herbs | | |
| SMIL. Species | <i>Smilacena species.</i> | Solomon's seal |
| DISPHOO | <i>Disporum hookeri</i> | Hooker's fairybells |
| TIAR. Species | <i>Tiarella species</i> | Foam flower |
| CLAYSIB | <i>Claytonia sibirica</i> | Siberian miner's lettuce |
| TRIELAT | <i>Trientalis latifolia</i> | Broad-leaved starflower |
| DICEFOR | <i>Dicentra formosa</i> | Bleeding heart |
| CORNCAN | <i>Cornus canadensis</i> | Bunchberry |
| LACTMOR | <i>Lactuca moralis</i> | Wall lettuce |
| ATHYFIL | <i>Athyrium filix-femina</i> | Lady fern |
| POLYMIN | <i>Polystichum minutum</i> | Sword fern |
| PTERAQU | <i>Pteridium aquilinum</i> | Bracken fern |
| DRYOEXP | <i>Dryopteris expansa</i> | Spiny wood fern |

north of the SFU Ring Road, both contain western hemlock dominated stands lacking other major tree species. On the south slope, a large block of predominately coniferous vegetation can be found. This type of conifer-dominated forest was not found elsewhere on the mountain.

3.3.3 Forest Structure and Succession

After Burnaby Mountain was logged in the early 1900's and again in the 1940's, little effort was made to re-establish the original mix of species (Crampton 1990). As a result, fast-growing species such as red alder established themselves during

early successional stages. The dominance of alder/maple communities is of concern for a number of reasons. Alder is a fast growing species that rapidly establishes itself in cleared areas. In some areas on Burnaby Mountain, alder stands are approaching maturity or over-maturity (red alder typically live 60 to 80 years). This aging is reflected in die back of upper crowns and signs of stem decay which make these trees susceptible to breakage under heavy snow or rain. While this community has value for some species, particularly when found on the fringe of coniferous stands, the predominance of mature alder/maple forests has reduced the overall diversity of habitats available for wildlife.

While some regeneration of hemlock and cedar is occurring, there are generally too few mature coniferous trees available as natural seed sources, thus making regeneration a slow process. However, regeneration of conifer species is occurring on many areas of the mountain, particularly on the margins of existing coniferous patches. If left to natural succession the forest will eventually return to a conifer-dominated climax forest. The composition of understory species will also shift to species more commonly associated with coniferous stands. In the short-term however, the forest vegetation of Burnaby Mountain will be less diverse overall. If desirable, obtaining a greater diversity of habitats in the short-term may be possible through limited intervention, for example, by planting or encouraging a different mix of species.

3.3.4 Forest Health and Diversity

Currently, deciduous species such as red alder and maple dominate most of the mountain forests. Large blocks of mature alder forests with little edge or diversity are less productive for many species of birds and wildlife (See Section 3.4.2). Additionally, most of these deciduous forests are even-aged and approaching maturity at the same rate. A time may eventually come when significant stands of forest will die off leaving insufficient cover for wildlife while regeneration occurs. While some regeneration of hemlock and cedar is now occurring, there are generally too few mature coniferous trees to seed. This means that the return to a climax coniferous forest more typical of the West Coast (though this is likely in the long-term) will be a slow process. In the short-term, obtaining a greater diversity of habitats may require some manipulation of forest vegetation. For example, planting or encouraging a different mix of species on an experimental basis is recommended in the Management Plan. While manipulating nature to meet specific management objectives can cause some concerns in the minds of the public, the forests of Burnaby Mountain have already been subject to considerable intervention and disturbance.

Overall, however, the forest of Burnaby Mountain appears healthy given its location amidst in an urban area and the level of use it receives. Scars, broken crowns, stem decay, and root damage were among the types of tree damage observed. Many of these instances can be attributed to natural factors such as forest maturation, use by wildlife, and natural disturbances such as wind and snowfall. Other types of damage (i.e., root exposure, vegetation trampling) are attributed to human use.

Inventories of Burnaby Mountain have recorded instances of dwarf mistletoe on hemlock trees throughout the study area. Dwarf mistletoe is a parasitic plant that develops first on trees or branches that are in the open, which make trees in urban areas more susceptible. Western hemlock are especially vulnerable to this disease which consists of non-woody shoots that invade the tree. A prime symptom of trees infested with dwarf mistletoe is the presence of 'witches broom' – a massive proliferation of branches from a single point. Other symptoms are distorted trunks, abnormally large knots or boles, lack of growth, reduced tree strength, evidence of infestations of insects or fungi, and dieback (B.C. Hydro 1998b). Along with these symptoms, the infestation of Dwarf mistletoe attacks the fibres of the wood, leading to weakened boles and limbs, and making trees more prone to damage from wind and accumulations of snow. This disease is fairly common in the habitat types found on Burnaby Mountain and elsewhere in the Lower Mainland. However, its implications on forest health are being more closely studied (e.g., Parks and Hoffman 1994). For example, research is currently underway to develop a biological control strategy (B.C. Hydro 1998b).

While forest disease, parasites and infestation may be naturally occurring phenomena, they have implications on forest health and public safety, therefore, the risks of these occurrences should be carefully assessed. Prevention or suppression of these should be brought forward to the public through public education programs.

3.3.5 Vegetation Management Issues

3.3.5.1 Human Disturbance

Outside of direct vegetation clearing for facilities or trails, the most significant cause of human disturbance to vegetation within the conservation area is off-trail hiking or riding. Vegetation trampling can be observed around trails and creeks throughout the mountain. Trampling may be caused by hikers and bikers veering from designated trails to avoid puddles, to go around other users, or simply to explore. In some cases, off-trail hiking or biking may be unintentionally caused by lack of directional signage or poorly defined trails. In other cases, new trails are intentionally created. Vegetation loss, caused by trampling, can lead to increased trail erosion and destruction of seedlings important for forest regeneration.

3.3.5.2 Fire Management

Prior to the establishment of Burnaby Mountain Conservation Area, SFU and the target ranges assisted with fire preparedness and maintained a capacity for fighting fires. The forests of Burnaby Mountain can be very dry during the summer months. Although a major fire on the mountain has never been reported, the City of Burnaby now has the primary responsibility for ensure public safety in the conservation area. The risk of fire has implications for public safety, protection of facilities and protection of adjacent property. For numerous reasons therefore, fires must be controlled within the conservation area. The status of existing fire response and containment equipment (e.g., hydrants and waterlines) and access routes should be

assessed for their sufficiency. As recommended in this Management Plan, Burnaby may also consider the possibility of cooperating with SFU and local industrial sites, which are required by law to have Fire Management Plans.

3.3.5.3 Hazard Trees

Hazard trees may pose a public safety concern. High winds and the occasional snowfall on Burnaby Mountain can cause stress on trees causing branches to snap, or whole trees to break or fall. This is particularly probable in areas of mature alder stands that are exposed to winds (e.g., near edges such as roads, trails or clearings). Measures should be taken to identify potentially hazardous trees and implement a hazard tree abatement program. Efforts should also be made to educate visitors about hazards and precautions.

3.3.5.4 Maintenance of Scenic Views

One of the conservation area's greatest features is its location, which provides select opportunities for unobstructed views of the surrounding region. However, opportunities to enjoy the panoramic views from the mountain are limited by the availability of clearings and elevated vantage points that permit viewers to see above or between stands of trees. Some of the existing available views are likely to be lost over future years in places where the forest is expanding into existing view openings. SFU's experience on Burnaby Mountain has shown that vegetation management is necessary to maintain scenic views and to inhibit regeneration of alder in cleared areas.

3.3.5.5 Utility Corridors

Vegetation management along utility corridors located in the conservation area needs to be coordinated within the context of a Vegetation Management Plan which will be developed for the conservation area. Some activities currently occurring along these corridors, such as the use of pesticides, can have impacts on the ecological and human use values of the conservation area. The City of Burnaby should work with landowners and leaseholders to promote sensitive vegetation management along these properties to reduce soil erosion, to curtail the spread of invasive species, and to increase the use of these corridors as habitat. Adoption of Integrated Pest Management Principles and Practices by the City of Burnaby is also recommended.

3.4 Wildlife and Habitat

Burnaby Mountain represents an important island of wildlife habitat in a predominantly urban area. The relatively large continuous tracts of vegetation offer potential habitat diversity, movement corridors, and migration stop-overs for numerous species of birds and wildlife. The preservation and enhancement of these habitats is an important component to consider in managing Burnaby Mountain Conservation Area for conservation purposes. Baseline data for wildlife species and habitat types are described in the sections below. More detailed information on

wildlife and bird species for Burnaby Mountain, Provincial species status (red, blue and yellow listings) and preferred habitats are presented in Appendices H and I.

3.4.1 Wildlife Species

3.4.1.1 Common Species Found on Burnaby Mountain

Wildlife inventories conducted as part of this study were able to confirm the presence of many species, but were limited by the seasonality and duration of the study. Field studies of Burnaby Mountain conducted by other researchers (e.g., Harrison and Letts 1995, New Pacific Ventures 1998, Sigma 1979, VNHS 1998) have also detailed the presence of numerous wildlife species and species groups including large and small mammals, birds, reptiles and amphibians. However, while species may be known or expected to occur on the mountain, their population sizes and dynamics are not entirely understood. To varying degrees, data gaps exist for most species groups and in particular for birds, small mammals and amphibians. More detailed studies and inventory work, and specific studies of key species, will be an important component of future research and conservation management efforts.

In contrast to much of the surrounding urban environment, Burnaby Mountain is large enough to support populations of medium-sized mammals. Black-tailed deer have been known to inhabit the mountain since the end of the last logging episode. However, sightings of deer have decreased considerably in recent years (Burnaby 1997c). One factor has likely been an increase in deer-vehicle collisions on the main mountain roadways, which resulted in the death of sixteen deer in 1996. Subsequent efforts by the City of Burnaby, the SPCA and the Ministry of Transportation and Highways to reduce the number of deer kills included the implementation of signage and reduced speed measures on Centennial Way. These efforts appear to have been successful and no deer have reportedly been killed in the conservation area since this time. Other potential factors influencing the number of deer sightings include an increase in human use of the mountain and a reduction in the amount of suitable browse habitat due to the presence of mature alder forests.

Regionally, a significant number of deer (estimated between 30 and 40) reportedly use the lands owned by petrochemical facilities adjacent to Burrard Inlet. The deer population here is reported to be healthy and fawns are frequently sighted. It is possible that the newly constructed Barnet Highway has limited deer migration between the Burrard Inlet foreshore area and Burnaby Mountain. However, in the absence of baseline data on the deer population and without a focused monitoring program, it is difficult to determine the current status of the deer population or the effects of human activities within the conservation area and the surrounding region.

Other wildlife populations and occasional migrants include coyotes, foxes and raccoons. Black bears have been known to visit Burnaby Mountain on rare occasions. However, the proximity to urban areas and the frequent occurrence of

humans and dogs on conservation area trails may discourage larger mammals from using these sites.

More commonly found in the conservation area are small mammals. Smaller mammals are an integral part of all terrestrial ecosystems and benefit other kinds of wildlife by providing a source of prey for a variety of predators such as hawks, owls, weasels, and coyotes (Banfield 1974). Several species of native small mammals use the forests, grassy meadows and clearings of Burnaby Mountain. Although not observed during field visits, other likely species include moles, voles, shrews and mice. Squirrels, rabbits, and chipmunks are also frequently observed on the mountain. Bat species present include the hoary bat, big brown bat and the *Myotis* species group (i.e., long-legged and long-eared species). These species are generally common throughout coastal British Columbia. However, as there are few larger natural areas (i.e., mature forest stands) in the Lower Mainland, Burnaby Mountain represents a relatively large proportion of remaining habitat for species (including bats) using mature forest stands. Although some bats use human-made structures for roosting, the "wildlife trees" found in Burnaby Mountain Conservation Area provide natural roosting opportunities.

Bird species found on Burnaby Mountain were typical of coastal forest habitats and most birds observed were common to the Lower Mainland (Campbell et al. 1990 and 1997). However, Burnaby Mountain provides good forest and early seral shrub habitat for birds and may also represent an important migration stop-over (Clulow pers. comm.; further studies are needed to confirm this). Additionally, the conservation area may provide year-round habitat for a range of songbirds such as dark-eyed juncos, spotted towhee, wrens, song sparrows, and chickadees. It also provides nesting and feeding opportunities for cavity nesters such as woodpeckers and nuthatches. Great horned owls, red-tailed hawks and downy woodpeckers are among at least fifty species of birds that use the mountain habitats. Other species, which do not nest in the conservation area, can also be observed flying overhead; these include barn swallows, swifts, gulls, and turkey vultures.

Three species were selected for more detailed analysis of habitat suitability: bats, black-tailed deer, and pileated woodpecker (See Section 2.2.5 and Appendix D). All three species have been observed on Burnaby Mountain and are expected to reside there either seasonally or year-round. These species were selected to represent a range of tolerances to human disturbance: high for bats; moderate for deer; and low for woodpecker. Maps showing habitat suitability on Burnaby Mountain for these three species are presented in Figures 3-4 through 3-6.

3.4.1.2 Provincially-Listed Species

No rare or endangered wildlife species were observed during the inventory component of the study, however, occurrences of rare species on Burnaby Mountain have been recorded. According to Conservation Data Centre (CDC) classifications (Table 3-4), at least eleven species of provincially blue and red-listed wildlife may be found at or near Burnaby Mountain based on the types of habitats

present and the geographic ranges of the species. Further wildlife surveys will be required to confirm the presence and status of these species in order to protect their preferred habitat types.

Listed species include four bird species, two amphibians, and five mammals (Table 3-5). The four Blue-listed bird species are the great blue heron, green heron, turkey vulture and Hutton's vireo. Amphibians include the Pacific giant salamander and the spotted frog (Lower Mainland population) both of which are Red-listed. Listed mammals that may inhabit the mountain include the Pacific water shrew (Red-listed), Trowbridge's shrew (Blue-listed), Townsend's mole (Red-listed), Keen's long-eared myotis (Red-listed) and Townsend's big-eared bat (Blue-listed). The presence of all of these species within the conservation area has not been confirmed, however, the ranges for each species may include Burnaby Mountain. At least one species (Hutton's Vireo) has been recently recorded within the conservation area. The provincial status of each species recorded for Burnaby Mountain Conservation Area is provided in Appendices H and I.

Table 3-4. Provincial Classifications for Listed Species of Wildlife

| <i>Classification</i> | <i>Description</i> |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Red List | Includes any indigenous species or subspecies (taxa) considered to be Extirpated, Endangered, or Threatened in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed. Red-listed taxa include those that have been, or are being, evaluated for these designations. |
| Blue List | Includes any indigenous species or subspecies (taxa) considered to be Vulnerable in British Columbia. Vulnerable taxa are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed taxa are at risk, but are not Extirpated, Endangered or Threatened. |
| Yellow List | Any indigenous species or subspecies (taxa) which is not at risk in British Columbia. The CDC tracks some Yellow listed taxa which are vulnerable during times of seasonal concentration (e.g., breeding colonies). |

Source: B.C. Conservation Data Centre (CDC 1998)






3.4.1.3 Introduced Species

Several introduced species of wildlife potentially inhabit the forests and grass areas of Burnaby Mountain, e.g., the grey squirrel and eastern cottontail. These species are common in the Lower Mainland and their establishment in urban parks and greenspaces is inevitable. Management actions to control or eliminate these species would be difficult.



LEGEND

Habitat Suitability Index (0.0 to 1.0)

- | | |
|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
|  High (0.7 - 0.90) |  Inaccessible |
|  Moderate (0.5 - 0.69) |  Insufficient data |
|  Low (0.3 - 0.49) | |

A Habitat Suitability Index (HSI) was developed to determine the relative suitability for each polygon to provide habitat for black-tailed deer. Variables considered included food (shrub cover and species), cover (forest density and tree height), and topography (slope and aspect). For winter habitat suitability, food was weighted as more important than cover. Refer to Appendix D for species selection criteria and methodology.

250 0 250 500 750 1000



Scale in metres
UTM Projection
NAD 83 Zone 10

Prepared by:
AXYS Environmental Consulting Ltd.



Figure 3-4: Relative Habitat Suitability for Black-tailed Deer (Winter)

Table 3-5. Provincially-Listed Wildlife Species which may be Found within Burnaby Mountain Conservation Area

| <i>Common Name</i> | <i>Scientific Name</i> | <i>Provincial Status</i> |
|---------------------------------------------|-------------------------------|--------------------------|
| Great Blue Heron | <i>Ardea herodias</i> | Blue |
| Green Heron | <i>Butorides striatus</i> | Blue |
| Turkey Vulture | <i>Cathartes aura</i> | Blue |
| Hutton's Vireo | <i>Vireo huttoni</i> | Blue |
| Pacific giant salamander | <i>Dicamptodon tenebrosus</i> | Red |
| Spotted frog (Lower Mainland population) | <i>Rana pretiosa</i> | Red |
| Pacific water shrew | <i>Sorex bendirii</i> | Red |
| Trowbridge's shrew | <i>Sorex trobridgii</i> | Blue |
| Townsend's mole | <i>Scapanus townsendii</i> | Red |
| Keen's long-eared myotis | <i>Myotis keenii</i> | Red |
| Townsend's big-eared bat | <i>Plecotus townsendii</i> | Blue |

Source: B.C. Conservation Data Centre (CDC 1998)

3.4.2 Habitat Types

3.4.2.1 Forested Habitats






At a broad level of categorization, four different forested habitats exist on the mountain: mixed deciduous-coniferous forests; mature deciduous-dominated forests; mature coniferous-dominated forests; and young seral forests. Mixed deciduous-coniferous forests are generally of the most value for habitat as they offer a greater diversity of species composition and age classes, and can therefore support a broader mix of bird and wildlife species. Mature deciduous-dominated forests and mature coniferous-dominated forests both offer moderate habitat values. While diversity is generally lower than in mixed stands, these forest types provide suitable cover, larger trees, and a greater number of dead or decaying trees. For example, many bird species use the mature alder-maple stands on Burnaby Mountain including Swainson's thrush, winter wren, red-eyed vireo, and chickadees. Young seral forests dominated by deciduous trees, particularly pure stands of alder, offer the least diversity. These areas are not well used by birds as the stands are too dense to fly through and have little productive understorey.

Coarse woody debris (CWD) is an integral component of forest diversity as it provides food sources, transit corridors, and shelter for a large number of conservation area inhabitants. CWD includes large woody material in the form of logs, root wads, bark, limbs, and stumps in various stages of decay on the forest floor. A detailed inventory of CWD on Burnaby Mountain was not possible in the scope of this study. However, given that the forests of Burnaby Mountain are not generally cleared of debris except around trails and roadways, it is very likely that a considerable amount of CWD is present in forested areas throughout the conservation area. Extensive use of CWD by small mammals (i.e., shrews, voles and squirrels) for foraging and shelter is well documented for other areas. In these cases, CWD is essential as a source of food to allow winter survival and to support



LEGEND

Habitat Suitability

| | | | |
|-------------------------------------------------------------------------------------|----------|-------------------------------------------------------------------------------------|-------------------|
|  | High |  | Inaccessible |
|  | Moderate |  | Insufficient data |
|  | Low | | |

A Habitat Suitability Index (HSI) was developed to determine the relative suitability for each polygon to provide habitat for pileated woodpecker. Variables considered include forest cover (type, density, structure and successional stage), number of snags, and the presence of trails. Refer to Appendix D for species selection criteria and methodology.

250 0 250 500 750 1000



Scale in metres
UTM Projection
NAD 83 Zone 10

Prepared by:
AXYS Environmental Consulting Ltd.



Figure 3-5: Relative Habitat Suitability for Pileated Woodpecker

a strong population. Other forest dwellers such as salamanders require CWD as sources of food and shelter in addition to moisture throughout the warm summer months. In this way, CWD supports many of the prey species that are essential for the survival of higher level predators. In streams, CWD creates habitat for amphibians, fish, and invertebrates.

A final component of forested habitats is the presence of standing snags or wildlife trees. These may be living or dead trees but are generally naturally occurring through successional process or natural disturbances (e.g., wind). Wildlife trees provide critical habitat for nest cavities, nest platforms, dens, roosts, hunting perches, foraging sites, and display stations during breeding. The value of a wildlife tree varies with factors such as age, size, structure, rot, species, elevation, and proximity to critical habitats. Species on Burnaby Mountain known to use wildlife trees include many species of primary and secondary cavity-nesting birds (e.g., woodpeckers and chickadees), birds of prey and insectivorous birds (e.g., swallows and flycatchers) and some species of small mammals (e.g., squirrels, chipmunks and bats). Vegetation surveys on Burnaby Mountain located and documented some of these trees although many more exist. Information on wildlife trees was integrated into habitat suitability models for selected species found on the mountain (i.e., woodpeckers and bats). Maintaining a large component of wildlife trees is integral to the provision of diversity in habitat for wildlife on Burnaby Mountain.

3.4.2.2 Grasses and Disturbed Landscapes

Several sites within the conservation area have been cleared of trees and are now maintained as developed areas. The open meadows near the Centennial Pavilion area, and other clearings and rights-of-way, have value as foraging areas for some species such as deer. These clearings also act as habitat for small prey species such as moles, voles, mice and rabbits which are a primary food source for raptors and small to medium-sized carnivores (i.e., fox, raccoon, coyote).

Where clearings and forests meet, edge habitats are created. Edge habitats have value for some species of birds and wildlife as they provide a greater diversity of habitat than an interior forest. For example, trails and rights-of-way constitute a special edge habitat for a variety of bird species offering food and shelter in close proximity. Along these sites, the removal of trees and resultant regeneration of shrubs and grasses potentially provide vast food resources for birds (i.e., seeds and insects) and deer (i.e., succulent new vegetative shoots on shrubs). Fly catchers and warblers are commonly found around such sites. Other species that benefit from edge habitats include robins, hummingbirds, towhees, wrens, song sparrows and bats. However, excessive edge is a feature of habitat fragmentation and can lead to a reduction in overall diversity.

Disturbed areas provide habitat by contributing to the diversity of forest cover, age and species, within the conservation area. Allowing these disturbed areas to progress through natural stages of regeneration provides a variety of habitat opportunities for bird and wildlife species present. However, while contributing to

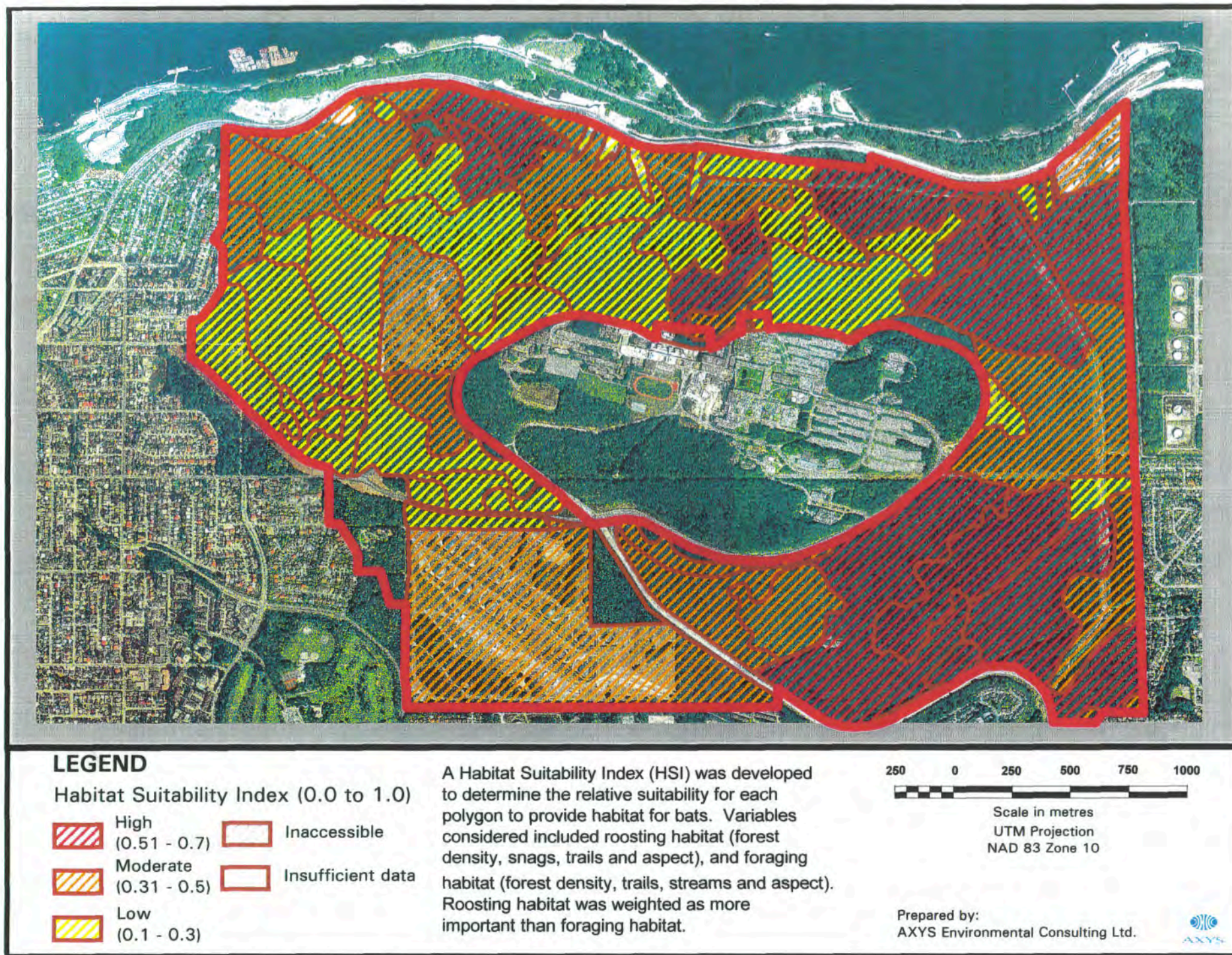


Figure 3-6: Relative Habitat Suitability for Bats

the habitat availability for some species, the removal of trees and ground cover does eliminate habitat for other species dependent on mature seral stages.

3.4.2.3 Aquatic Habitats

Watercourses on the southern and eastern sides of Burnaby Mountain have lower gradients than those found on the steep northern side, resulting in higher fish-bearing potential. Additionally, recent efforts by local stewardship groups have significantly increased the fisheries potential (spawning and rearing capability) for southern slopes waterways such as Eagle Creek and Stoney Creek, and for Silver Creek to a lesser degree (see Section 3.5.2). These creeks have historically supported, and continue to support, populations of coho salmon, steelhead (Stoney Creek only) and cutthroat trout along various sections of their length (BCIT n.d., M. Zallen and Associates 1989, Bedo 1996, Fink and Benegeyfield 1995).

In addition to their values as fish habitat (generally described in sections 3.5.2 and 3.5.3), creeks and ditches on Burnaby Mountain also provide habitat for invertebrates, reptiles, and amphibians and a source of food and water for birds and mammals. At least six species of herptiles are reported to inhabit the mountain including the western toad, pacific treefrog, common garter snake and several species of salamander. Insectivores such as shrews and moles use riparian habitats as foraging areas for insects (e.g., stone fly nymphs) and invertebrates (e.g., earthworms). Some insectivores, such as the water shrew, are adapted to swimming and pursue small fish and larval salamanders.

Riparian areas on Burnaby Mountain also provide habitat for a wide range of mammals by providing a source of drinking water and potential foraging areas. Raccoons commonly hunt within and along streams for fish, rodents and amphibians. The coastal black-tailed deer population on Burnaby Mountain uses riparian areas for thermal cover and security, and for drinking water and as sources of browse such as willow, sword fern and salmonberry. Riparian areas also provide important corridors for the movement of wildlife and connect regional ESAs such as Burnaby Mountain and Burnaby Lake.

3.4.2.4 Habitat Diversity and Connectivity

Different species of wildlife prefer different types of habitat. While habitats can be altered to favour one species over another, managing for the greatest habitat diversity is an important conservation objective in many parks and conservation areas. To achieve a high level of diversity in Burnaby Mountain Conservation Area, some manipulation of forest vegetation may be required. The City of Burnaby should also work with surrounding land users (i.e., SFU, industry) to ensure that habitats provided by these adjacent lands are accessible to wildlife. For example, some species may benefit from clearings or edge habitat provided by abutting properties thus eliminating the desire to create such habitats in the conservation area. However, if these properties are fenced, the habitat is effectively lost.

For many species, habitat requirements are often varied requiring them to move between different habitat types on a daily or seasonal basis. Consequently, a species may choose to move between habitats when all of their habitat requirements are not met in a given area, or where habitat has become degraded due to other factors. For Burnaby Mountain, these movements may be small, local shifts to other parts of the mountain, or regional migrations in and out of the conservation area. In either example, safe and accessible movement corridors are essential. Wildlife movement patterns on Burnaby Mountain are not well understood although there appear to be some natural movement corridors.

Wildlife movement corridors have been identified from observations and from the locations of known wildlife trails, particularly those used by deer. Main deer trails cross Centennial Way and occur at the intersection of Gagliardi Way and the SFU Ring Road, south of the Ring Road, and in areas on the lower north side of Burnaby Mountain. Wildlife also use existing trails and rights-of way although this may be influenced by an individual species' tolerance to humans. In addition, any large block of land that is not restricted or fragmented by roads, trails or human development, can be considered a type of corridor as it generally allows free and safe movement of wildlife.

Other corridors or travel routes on Burnaby Mountain may be much less conspicuous than those of the black-tailed deer but are equally important. Many of the medium-sized carnivores such as coyote, fox and raccoon continually travel in search of food for themselves and their young. These corridors provide forage potential, security cover, thermal cover, and secure denning and bedding areas. The importance of these corridors cannot be understated in the maintenance of the resident and transient wildlife population on Burnaby Mountain.

3.4.3 Wildlife Issues

3.4.3.1 Habitat Loss and Fragmentation

The landscape of Burnaby Mountain is fragmented by the presence of existing roads, facilities, and land uses. There is a justifiable concern by the public that more parking lots, trails, and human use will lead to a loss of habitat and further fragmentation. Both habitat loss and fragmentation have negative effects on most wildlife species, particularly those that require interior forest features, and those that require safe movement corridors away from humans. While trails are less intrusive than paved roads and facilities, they nonetheless result in the loss of some habitat in addition to providing access into forested habitats by humans. While the smaller forest clearings created by trails can have some benefits for wildlife such as opening up the forest canopy and providing forage habitat for some species, trails are also a direct source of fragmentation. For example, while crossing trails, smaller species such as herptiles and small mammals are more susceptible to direct impacts from humans, bikes or dogs. Brood parasitism by cowbirds, and predation by other bird species and mammals, are also a concern in fragmented habitats.

Although there are no plans for extensive facilities, increased use of the conservation area will likely lead to the ad hoc creation of new trails by people branching out from designated areas. This could have serious implications unless efforts are taken to prevent and mitigate off-trail use. There is also concern about the effects of growth and development at SFU on habitat quality. An increase in the SFU community will lead to more use of the conservation area, and new roads to service the increased campus population may eventually be required. Other potential impacts include direct habitat loss from facility construction, fragmentation and indirect loss of habitat, increased wildlife mortality along roads, and sensory disturbances from increased noise or human presence in the area.

3.4.3.2 Human Disturbance

In addition to linear developments such as roads, pipelines, rights-of-way and trails, humans themselves are a source of direct and indirect disturbance to wildlife. Human disturbances to wildlife include sensory disturbance (e.g., noise or human presence); direct mortality (e.g., vehicle collisions or pet attacks); and indirect mortality (e.g., feeding of wildlife by humans or ingestion of toxic pollutants from roads). Disturbances to wildlife habitat may include: nest destruction; disturbance causing nest desertion; direct loss of habitat; or degradation of habitat quality. Off-leash dogs are a cause of many of these types of disturbance, particularly direct mortality and nest destruction and disturbance.

Even relatively slight alterations of habitat by humans may affect bird breeding grounds, migration stops, as well as wintering areas. These alterations can affect a population's ability to sustain itself by leading to a reduced gene pool or increased predation on nesting birds. Human activities are known to impact raptors in at least three ways: 1) by physically harming or killing eggs, young, or adults; 2) by altering habitats; and 3) by disrupting normal behaviour. The extent of impacts will vary depending on life stage, time of year and varying levels of sensitivity among individual raptors. Resulting effects include nest losses, energy loss caused by avoidance flights, and interference with feeding activities.

3.4.3.3 Black-tailed Deer Management

While there are no exact figures on the number of black-tailed deer that inhabit the conservation area, the population has been estimated to be between 25 and 50 animals. An evaluation of the mountain's habitats indicates that the most highly rated habitat for deer is located west of Centennial Way, a main access road for visitors of the conservation area. This has also been the location of several collisions between deer and vehicles resulting in a high deer mortality rate for 1996 (sixteen deer were killed on Burnaby Mountain in 1996 including thirteen females).

As a result of measures taken by the City of Burnaby to reduce the risks of deer-vehicle collisions, deer mortality from vehicles seems to have declined. However, the deer population is still not well understood and effects of the high mortality instances may not be observed in the population for many years. Additionally, as forested habitats on Burnaby Mountain evolve and mature, some habitat values for

deer may be lost. This may be causing a natural migration out of the conservation area and into younger forest stands with more and preferred browse species. Nearby industrial properties such as the Trans-Mountain and Petro Canada facilities, provide some suitable browse habitat for deer. It is recommended through this Management Plan that efforts be made to work with other landowners to ensure these adjacent habitats are accessible to deer and other wildlife.

3.4.3.4 Regional Wildlife Issues

Burnaby Mountain represents an island of wildlife habitat in a predominantly urban area. Maintaining green links and corridors between patches of habitat is critical. Burnaby Mountain is believed to be a significant migration trap for migrating birds in the spring. Other wildlife species likely migrate between Burnaby Mountain and other parks in the region (e.g., Burnaby Lake and Deer Lake parks) and may even cross over between Burnaby Mountain and the North Shore (e.g., deer have been spotted swimming across the Burrard Inlet). Protecting the habitat values of the mountain will have implications beyond the immediate site-level.

3.5 Watercourses

3.5.1 Distribution

Low order streams (i.e., tributaries or primary drainage) drain precipitation from the crest of Burnaby Mountain into surrounding watersheds. Watercourses found within the conservation area are concentrated on the southern and northern slopes of the mountain. The western and eastern slopes are generally devoid of major watercourses although ditches associated with trails or utility lines provide relatively stable drainage channels during periods of heavy runoff. Currently, storm drains remove excess water from the university campus, directing it to receiving creeks in the southeast portion of the mountain via a stormwater diversion system. The remaining precipitation is absorbed directly into the soil and forms sub-surface flow that is released into streams over a longer duration.

Most streams on Burnaby Mountain are dry in summer, although there remain wet hollows during even the driest seasons. Because the mountain contains a small catchment area and steep slopes, there is extremely rapid runoff after heavy rainfall. Excess water that cannot be absorbed by the surface can be seen running over the land surface along multi-channeled temporary courses, progressively converging into permanent channels. Studies of streams and major tributaries found on Burnaby Mountain include BCIT n.d., M. Zallen and Associates 1989, Bedo 1996, Fink and Benegeyfield 1995, and New Pacific Ventures 1998. These watercourses are shown in Figure 3-7.

3.5.2 Groundwater

Very little information exists for groundwater on Burnaby Mountain. Much of the flow of water on Burnaby Mountain is sub-surface although it generally occurs near

the surface and within unconsolidated surficial sediments. This is evident by the vegetation and soil conditions and the fact that some areas are wet and boggy during the winter, which is indicative of sub-surface flow. Springs have also been noted on the north slope demonstrating that groundwater collected in near the top of the mountain is seeping below ground and reappearing at lower elevations where topography and soil conditions change. Members of the former target ranges, particularly the western most Burnaby Fish and Game Club, have also reported substantial water accumulation on these properties that they believe is the result of groundwater seeping to the surface once it reaches more level topography.

3.5.3 Brunette Watershed

On the south slope, watercourses that originate on Burnaby Mountain drain into three main stream systems: Stoney Creek; Silver Creek and Eagle Creek. All are part of the Brunette River System, which drains much of Central Burnaby.

Stoney Creek receives most of the water discharge from Burnaby Mountain. Of the Burnaby Mountain watercourses, this creek has the greatest potential to support fish due to its higher flows. Stoney Creek is recognized by the Department of Fisheries and Oceans (DFO) as the most important salmonid stream in the Brunette River watershed. It provides year-round rearing habitat for coho salmon, steelhead and cutthroat trout.

A significant number of fish are released in Stoney Creek each year through enhancement programs such as the annual "Great Salmon Send-Off." Stoney Creek is also an important corridor of green space connecting Burnaby Mountain Conservation Area and Burnaby Lake Regional Nature Park.

The upper watershed of Stoney Creek includes several tributaries found within Burnaby Mountain Conservation Area. The creek's largest tributary originates on Burnaby Mountain and offers good spawning and rearing habitat for cutthroat trout and coho. Despite high use and urban development along much of its length, the Stoney Creek system continues to support a sizeable fish population. However, problems such as fish migration barriers (outside of the conservation area) and sedimentation (inside and outside of the conservation area) are having detrimental effects on the health of the stream. Other problems include extreme peak flow events leading to washouts and erosion and occasional spills, which have resulted in fish mortalities.

Some of these issues are currently being addressed through the noteworthy volunteer efforts of the Sapperton Fish and Game Club and the Stoney Creek Environment Committee. In addition, a pilot project under the Brunette Basin Task Group has been initiated by the City of Burnaby, the GVRD, SFU, and regional municipalities to develop an integrated stormwater Management Plan for the Stoney Creek Watershed which will address environmental protection and enhancement issues as well as stormwater conveyance.

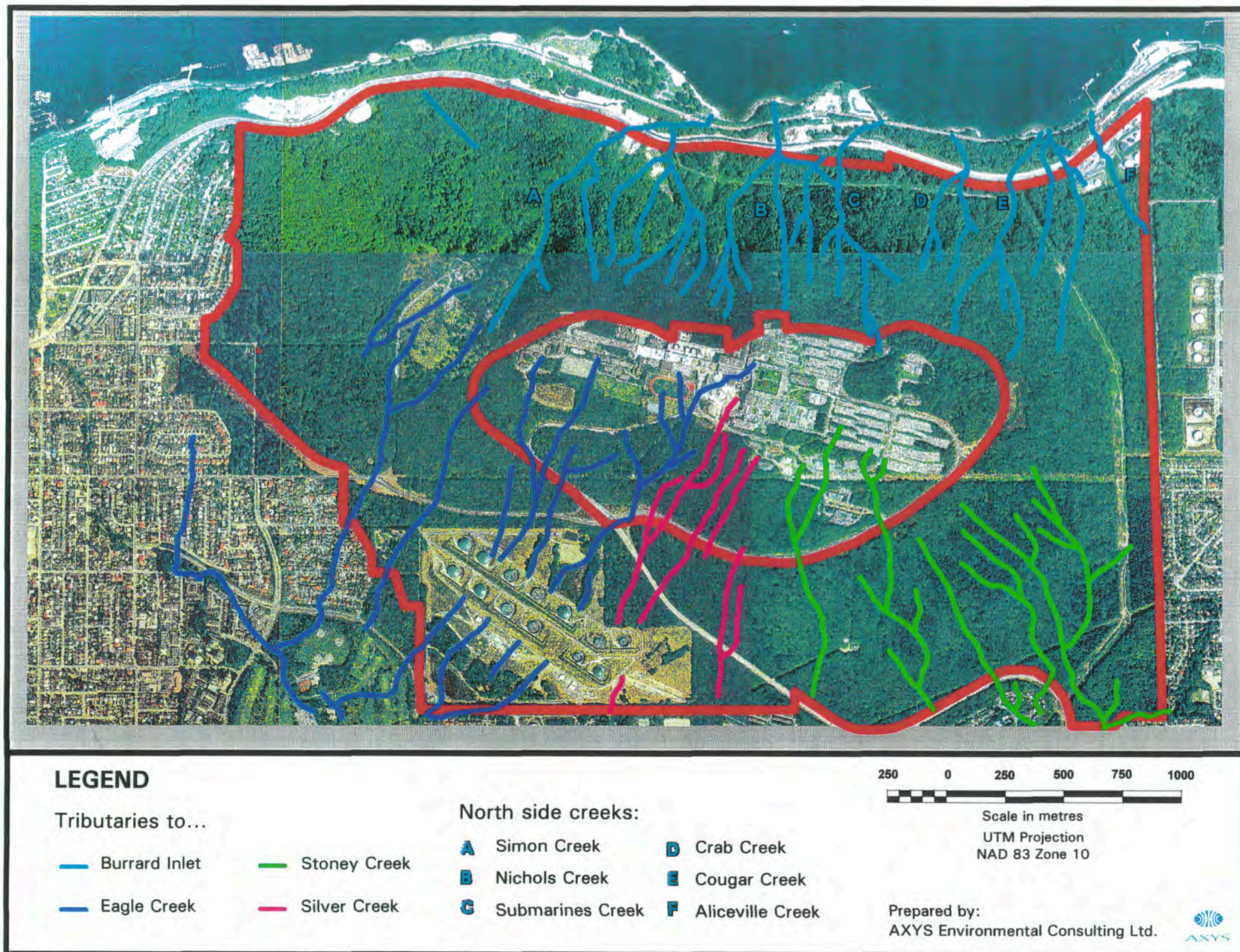


Figure 3-7: Watercourses in the Burnaby Mountain Conservation Area

Eagle Creek also drains the south slope of Burnaby Mountain. The creek begins at a culvert beneath Centennial Way then flows approximately 10 km through residential, park, and industrial areas within the City of Burnaby. Many of the headwater tributaries of this creek are characterized by high channel gradients and an ephemeral or intermittent flow regime. Short sections are culverted under the Burnaby Mountain Parkway (i.e., the Hastings-Gaglardi Connector) and under Curtis Street. The Creek eventually enters Burnaby Lake at Warner Loat Park. The Trans-Mountain Pipeline Terminal is situated within the Eagle Creek drainage basin on the southwestern slope of Burnaby Mountain. Flows from upper Eagle Creek, above the terminal, are diverted through a buried culvert designed to by-pass the terminal property. Historically this creek has supported coho salmon spawning in its mid and lower reaches and cutthroat trout have also been documented. However, the upper reaches of the creek which are contained within Burnaby Mountain Conservation Area are likely of too high a gradient to be of use as fish habitat.

Silver Creek originates on Burnaby Mountain between Stoney and Eagle Creeks. Silver Creek flows directly into Burnaby Lake upstream of the Cariboo dam. The lake then flows into the Brunette River. It is believed to offer less desirable fish habitat due to human disturbances (mostly culverts) despite the fact that both the upper section and a small portion of the lower section are protected in parks (Burnaby Mountain Conservation Area and Burnaby Lake Regional Park respectively).

3.5.4 Burrard Inlet Watershed

Streams on the north side of Burnaby Mountain have recently been inventoried as part of the Burrard Inlet Watershed Environmental Inventory and Assessment Study (New Pacific Ventures 1998), and all have recently been named as part of the City's Heritage Creek Naming Project. On the north side of Burnaby Mountain, drainage systems flow directly into Burrard Inlet. Steep terrain in this area results in little opportunity for lower gradients sufficient to provide fish bearing capability. Watercourses on the north slope are less likely to sustain fish populations due to factors such as steep slopes, lower water flows, and human-made impediments. For example, most of the large concrete culverts that have been installed to route these streams under the Barnet Highway are very disruptive to stream processes and pose significant obstacles to fish. Insufficient flow during dry periods also poses a concern with respect to fish habitat potential.

Many of the streams here are intermittent (low or no flow during dry seasons). In addition, these streams generally have a lower in-stream storage capacity likely attributed to natural features such as short and steep channels. Relatively high sediment loads are also expected given that the channels are continually adjusting to small shifts and movements of the slopes, and that the substrate of these streams are mostly comprised of easily erodable materials. Stream restoration or enhancement work in these areas may be futile given geological characteristics and the potential for local slope failure. However, although the upper reaches of these

streams are not capable of providing spawning or rearing habitat, they do contribute to the capability of lower reaches to support fish.

Despite these factors, at least one stream on the north slope of the mountain is believed to be an appropriate candidate for restoration and enhancement efforts. Simon Creek, which flows through the site of the former target ranges, contains relatively good habitat for salmon and trout (New Pacific Ventures 1998). Simon Creek is fish passable under the Barnet Highway. A series of jump pools leading to a culvert were constructed as part of the Barnet Highway upgrade. Frequent maintenance of these jump pools is necessary as they tend to clog with gravel. There is evidence to suggest that years of target shooting at the ranges near Simon Creek has resulted in higher concentrations of lead and copper in soils, surface water and groundwater (to a lesser degree) than would normally be expected or considered suitable for aquatic life (Gartner Lee 1998). A recent study of the target range sites provided data on the level of site contamination and looked at potential means of mitigation. If restoration of the site and stocking were to occur, Simon Creek may support viable fish populations due to the presence of other habitat attributes.

3.5.5 Aquatic Habitat Types

3.5.5.1 In-Stream Aquatic Habitat

The upper stream reaches of Burnaby Mountain tend to be mostly confined, V-shaped, ephemeral channels due to their location on the slope. Consequently, braided channels and side channels required for rearing and spawning habitat are non-existent in the upper reaches. This is not uncommon for low order streams and must not be inferred to be a deficiency of the system; most headwaters have these characteristics.

The lower stream reaches within the conservation area have higher value as rearing and spawning habitat. This results from lower gradients and sufficient and continual volumes of water throughout the year. The presence of small, complexed pools (i.e., containing large organic debris) and undercut banks provide some refuge for resident and spawning fish. The streams on the south slopes exhibit these conditions at lower elevations where topography evens out and tributaries come together to increase water flow. On the north slope, gradients are generally too steep in the reaches within the conservation area to provide suitable habitat (although these streams do level out before they reach the Burrard Inlet). Simon Creek may be one exception due to less-steep conditions and the presence of sub-surface water that reaches the surface during higher flow periods and has resulted in a higher volume of water accumulation than other streams in this part of the conservation area. This stream may benefit from enhancement activities (see Section 3.5.3)

Although the streams within Burnaby Mountain Conservation Area have moderate to minimal value for fish habitat, they are essential as food sources. Many aquatic insects (e.g., stone fly, black fly and may fly) thrive in fast moving water and

become available to fish as they die. These insects require fast, clean water to fulfill their life cycles to benefit downstream fish stocks. Additionally, the lower reaches provide excellent habitat for aquatic insects requiring slower moving water for their life cycle, such as the stone fly and the dragonfly. Based on documented fish presence, it is believed that vegetation and soil components on Burnaby Mountain are acting as a filter and slow-release agent for watercourses.

3.5.5.2 Riparian Vegetation Habitat

All watercourses on Burnaby Mountain affect local vegetation composition by increasing moisture available to plants. This local vegetation is important for fish, insects, birds, and other wildlife. It provides thermal cover, food sources, and moisture retention. These habitat characteristics are required by many fish, mammal, bird, and amphibian species found on Burnaby Mountain.

Streamside vegetation is extremely important in the provision of shade for maintaining low water temperatures required in the salmonid life cycle and as habitat for insects that eventually drop into the water as a food source for downstream fish. Most streams are sheltered at least by a minimal amount of overstream vegetation on Burnaby Mountain, aiding in efforts to re-establish resident (i.e., cutthroat trout) and anadromous (i.e., coho salmon) fish populations.

Diverse streamside vegetation was observed on Burnaby Mountain. Shrub species such as salmonberry, vine maple, red alder and Himalayan blackberry are augmented by canopy species of Douglas-fir, western hemlock, western red cedar and bigleaf maple. Diversity in streamside vegetation attracts a wider range of insects resulting in a higher potential for a healthy fish population. Additionally, certain bird species are attracted to riparian shrub species for foraging and security reasons.

Riparian vegetation also assists in the retention of sub-surface moisture through shading and the root-soil interface. Such vegetation lessens impact erosion of rainfall with its foliage and through the rooting mat, acts as a sponge to slowly release water to the stream over a longer period. This moisture is most prevalent along the watercourses of Burnaby Mountain especially during warm summer months on the southern aspects. Many amphibian species found on Burnaby Mountain use this moist habitat throughout their life cycles. For example, the western red-backed salamander requires moist areas as general habitat as well as for breeding habitat.

3.5.6 Issues Affecting Watercourses

3.5.6.1 Human Disturbance

Habitat loss and degradation are among the most serious issues of fish protection in the Lower Mainland. Urban development outside of the conservation area, and human use within the conservation area, can have adverse effects on watercourses and their potential to sustain fish populations. Issues associated with aquatic habitat on Burnaby Mountain include: increased sedimentation due to human

activity near streams; damage caused by the creation and use of unauthorized trails through or along creek beds; removal of aquatic vegetation; and increased stormwater flow from SFU.

Trails should be diverted away from riparian areas as much as possible. Where this is not feasible, trail and bridge design will consider the environmental impacts to streams, e.g., constricted stream flow, increased sedimentation, erosion. Concerns regarding the effects of sediment levels in watercourses are based on an extensive body of background research and investigation. In general, concerns are related to increased levels of suspended particulates in the water and sedimentation on the bottom of stream channels. Both situations have adverse effects on fish productivity and fish habitat.

3.5.6.2 Future Development at SFU

Drainage issues faced by SFU include: maintenance of adequate drainage and conveyance systems for existing and future conditions; development; management of stormwater runoff rates and volumes; and management of stormwater runoff quality. SFU development plans call for more surface hardening which typically creates increases in the peak runoff rate which could have implications on conservation area streams. Additionally, infiltration of rainfall may decrease as water is channeled into drainage systems. This can lower the existing water-table and reduce groundwater retention, contributing to lower flows in the summer. Conversely, increases in surface flow may lead to direct erosion of natural watercourses and impacts to downstream systems. These problems are exacerbated because of the steep slopes encountered on Burnaby Mountain.

The SFU Official Community Plan (OCP) (Burnaby 1996b) states that a Stormwater Management Plan must be in place before development begins and that this plan must demonstrate that development will not adversely affect existing watercourses. The plan calls for the maintenance and control of water flows based on a no-net-increase of flows to off-site areas following development. This will partially be accomplished through the use of detention ponds. However, members of the public are concerned that stormwater runoff generated from future development at SFU will have serious adverse implications for watercourses on Burnaby Mountain, particularly those located on the southern slopes. There is also concern regarding the effects of construction-related sedimentation on local creeks and streams.

3.5.6.3 Water Quality

Water quality in streams was not monitored as part of this study. However, data is available for main systems on the south side, and water quality for north slope streams has been assessed through the Burrard Inlet Watershed Environmental Inventory and Assessment Study. Water quality on the mountain is not believed to be a significant issue at this time. However, lead seepage into streams and groundwater near the site of the former target ranges has been recently investigated (Gartner Lee 1999). Groundwater samples collected from two of the target range sites found contained concentrations of dissolved lead which were

slightly higher than the aquatic life water numerical standard. It was concluded that groundwater contamination from target range activities was minimal. However, surface water sampling clearly identified a source of lead and copper in the vicinity of the ranges. It was also determined that these contaminants were migrating off-site via Simon Creek, which eventually flows into the Burrard Inlet (Gartner Lee 1999). Concentrations of Copper and lead were highest in the east branch of Simon Creek that drains the former Barnet Rifle Club range.

Other sources of water quality degradation include sedimentation from trails, and pollution from roads and nearby urban developments.

3.5.7 Stream Stewardship

Recent efforts by local stewardship groups, such as the Stoney Creek Environment Committee, The Sapperton Fish and Game Club, and BCIT have significantly increased the fisheries potential (spawning and rearing capability) for waterways such as Eagle Creek, Silver Creek and Stoney Creek (see Section 3.5.2). Other rearing efforts, such as those of the Burnaby Fish and Game Club, have raised public awareness of fisheries and habitat issues in general. The Burnaby Fish and Game Club has used Simon Creek on Burnaby Mountain for raising 100,000 spring salmon annually that are released into the Burrard Inlet. These types of efforts should be encouraged to continue.

3.6 Environmentally and Ecologically important areas

3.6.1 Regional Significance

Burnaby Mountain as a whole is considered an environmentally sensitive area within the City of Burnaby. Principles for planning and managing ESA have been developed as part of the City's ESA strategy and must be reflected in the recommendations of the plan (See Appendix B).

3.6.2 Locally Significant Areas

An analysis of ecological components was conducted at the conservation area level as a means of displaying and summarizing data on vegetation, habitat, and watercourses (VHW). As part of the analysis, distinct polygons on the mountain (as defined through the biophysical inventory) were classified according to their relative ecological uniqueness or sensitivity. A detailed explanation of the methodology for this analysis is presented in Appendix E.

Based on this assessment, three areas of the conservation area were rated as most significant in terms of VHW criteria (Class 1 and 2). A large block of significant habitat was identified on the south slope of the mountain (Figure 3-8). This was the only part of the conservation area that received a Class 1 rating (the most significant). The high rating here was mainly attributed to the presence of fish-bearing watercourses and to the moderate to high habitat ratings for the selected

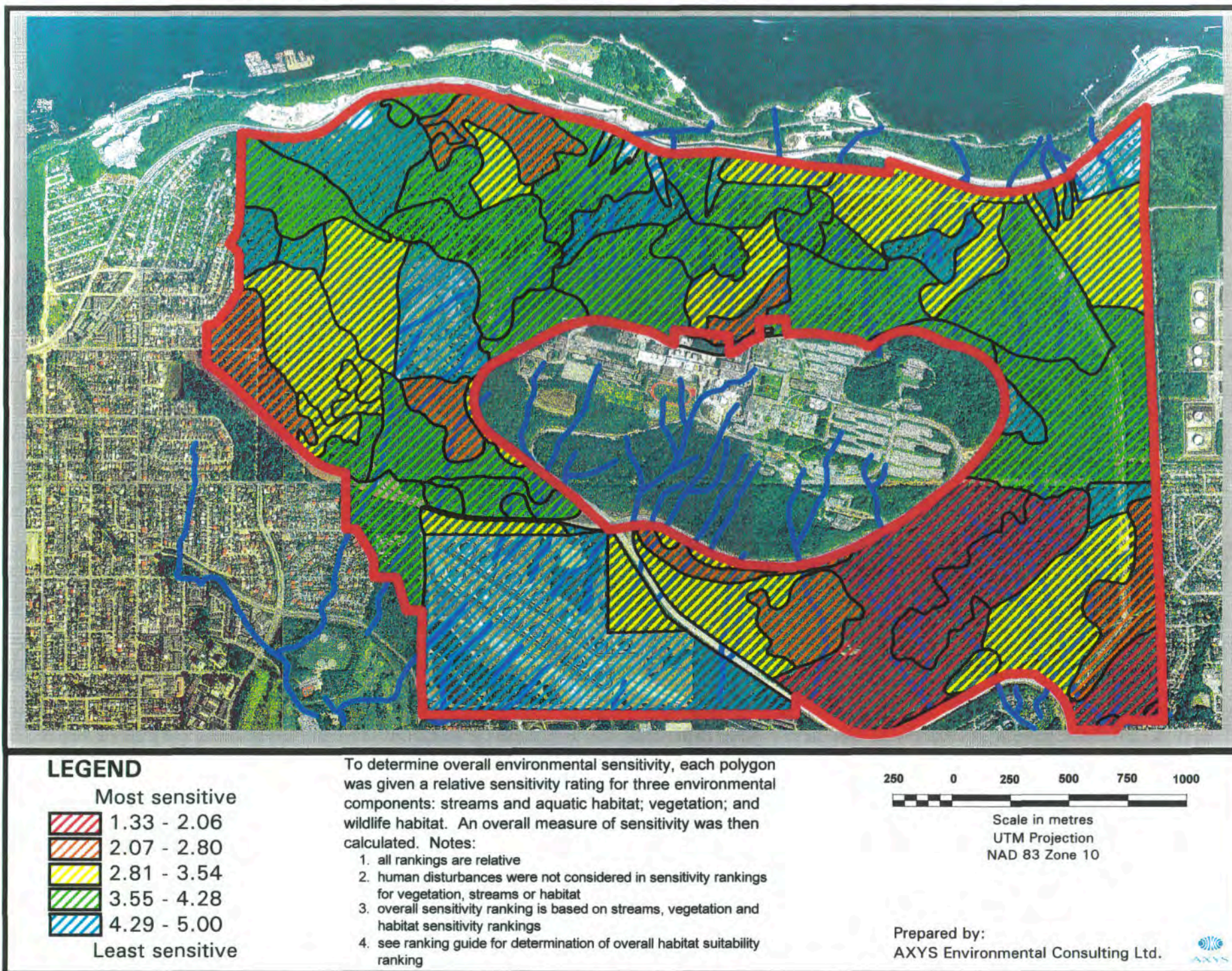


Figure 3-8: Relative Sensitivity based on Vegetation, Watercourses and Wildlife Habitat

indicator species (ranking for habitat was based on an average suitability score for deer, bats and pileated woodpecker; see Appendix D). High vegetation values were also attributed to the areas of predominately coniferous vegetation, as this type of conifer-dominated forest was not found elsewhere on the mountain.

Other parts of the mountain rated as moderate to low significance when considering vegetation, habitat and stream values. Most of the north slope rated Class 4 due to the presence of relatively common vegetation, the lack of known fish-bearing watercourses, and the low habitat values for deer due to steep slopes and cooler exposure. However, not included in the VHW classification is a ranking for slope sensitivity, which in the case of the north slope, is very high. When terrain is factored into the analysis, the high terrain sensitivity on the north slope "cancels out" the lower ecological sensitivity and the ratings become more moderate (i.e., Class 3). The opposite is true to the south slope where high ecological values are balanced by low terrain sensitivity, again resulting in generally moderate values. Thus terrain conditions were excluded from the analysis.

The lower western slopes were also rated as relatively significant (Class 2). This ranking was mainly attributed to higher vegetation values. Two vegetation communities found in this section were unique to the conservation area (a mixed hemlock-cedar stand with alder and maple as sub-dominant species; and a cedar-sitka spruce stand). A third community found here was only identified in one other part of the conservation area (big-leaf maple with cedar and hemlock as sub-dominant). Two areas on the north slope received Class 2 ratings: the lower north-western slope between the Harry Jerome Sports Centre and the former target ranges; and a small area immediately north of the SFU Ring Road. These areas rated highly based on vegetation and habitat values. Both contain western hemlock dominated stands lacking other major tree species. This vegetation type also exhibits higher habitat values for bats and woodpeckers.

3.6.3 Human Disturbance

Individual sites or areas on the mountain exhibit characteristics that make them relatively more sensitive than others. The most ecologically sensitive area of the conservation area comprises a portion of the southeastern slopes due to a combination of wildlife, watercourse, and vegetation values. This area is also the most heavily used due to easier access, gentler slopes, and the number of existing trails created by various user groups. Protecting these values while still maintaining the same level of recreational opportunities may be incompatible with the conservation objectives of the conservation area. Reducing some access routes and monitoring human use within more sensitive areas was considered during the planning process and was reflected in a number of the conceptual options (See Appendix J).

3.7 Historical, Cultural and Recreational Resources

3.7.1 Historical Resources

There is little evidence of First Nations use of the mountain prior to European settlement. The area was certainly used for hunting and other activities but settlement was more likely to have occurred along the Burrard Inlet. The known archaeological sites in the nearby area occur along the shores of Burrard Inlet and indicate frequent First Nations use of the waterfront.

Burnaby Mountain was first surveyed by the Royal Engineers in 1859 in an effort to find a direct land route between New Westminster and the waterfront. North Road was constructed shortly afterward as a rough wagon road to provide a link to Burrard Inlet for military purposes in the event of warfare in the winter when the Fraser River might be frozen. The North Road route soon attracted scattered settlement. At the waterfront terminus of the road, several summer cottages, two hotels, and a ferry landing were established by the turn of the century. The remaining right-of-way is still intact for a significant section of its route adjacent to Burnaby Mountain Conservation Area. This last remaining section of colonial trail is recognized in the City of Burnaby's Heritage Resource Registry and is intended to be preserved, interpreted, and integrated into Burnaby's trail network. A house from 1912 exists on the easternmost target range site. The house was part of a grouping of buildings in an early settlement on the waterfront and served as the residence for the school teacher. It was moved to its current location in the past and is not officially recognized as a heritage site.

Burnaby Mountain was extensively logged during the early years of this century. Logging of the forest cover started in 1903 to send logs to sawmills along Burrard Inlet. By 1912, the mountain was virtually cleared of its large trees, except in several ravines on the southern slopes and on a few cliffs on the northern slopes.

The conservation area has not been systematically investigated for potential archaeological resources and no sites have been identified through related field research. Evidence of early use would likely have been substantially disturbed in the course of the initial logging. In fact, little evidence of Burnaby's First Nations or pioneer history remains with the exception of the North Road Trail at the eastern edge of the conservation area.

3.7.2 The Centennial Pavilion area

City-owned lands on Burnaby Mountain were identified as a desirable park location in the early 1930's although a number of land exchanges occurred throughout the area which affected park potential. This included the development of the Trans-Mountain facility in 1952 and the establishment of Simon Fraser University in 1963. In 1957, a substantial part of Burnaby Mountain was declared a public park and, in 1958, the Centennial Pavilion was created as the first park facility to commemorate British Columbia's Centennial. Today, most of the park area is preserved as a conservation area in forest cover. The few cultural and built recreational resources

are concentrated in the immediate vicinity of the Rose Garden and Horizon's Restaurant within the original Burnaby Mountain Park (the area surrounding the Centennial Pavilion) (Figure 3-9). These include:

- the 'Burnaby Columbian Centennial Totem' carved by Lloyd Wadhams and Godfrey Hunt and dedicated on the occasion of Canada's Centennial in 1967
- the 'Feather Power' totem pole carved by William and Rupert Jeffrey in 1971 as part of a Burnaby Art Gallery exhibition and located in the park in 1972
- the 'Playground of the Gods' or 'Kamui Mintara', a group of wood sculptures, created in 1989 by Ainu sculptors Nuburi and Shusei Toko to commemorate twenty-five years of a sister city agreement between Burnaby and Kushiro, Japan
- the Burnaby Centennial Rose Garden which opened in 1992 is a key attraction for both residents and tourists
- a sports mural made of mosaic tiles associated with the 1973 Canada Games held in New Westminster and Burnaby
- the children's playground offers families a destination within the conservation area and also serves the children in the residences and daycare programs at SFU (This playground was partially funded through a donation)
- Horizon's Restaurant and the adjacent concession stand
- large open lawn area used for informal recreational activities and picnicking
- a major parking lot to serve visitors (the only off-street parking currently available to conservation area users outside the SFU Ring Road).

3.7.3 The Former Target Range Sites

Three outdoor target ranges have occupied sites along the north boundary of the conservation area adjacent to the Barnet Highway for many years. The combined area of the three ranges equals approximately 26 acres. The leases to operate these facilities were terminated in 1998 and the lands will revert to conservation and park uses. In addition to the cultural features located in the Centennial Pavilion area, the house from 1912 on the easternmost target range site may have some heritage value. The house was part of a grouping of buildings in an early settlement on the waterfront and served as the residence for the school teacher. It has been moved to its current location.

The best use for the lands and associated facilities will be incorporated into the design plans for the conservation area. Evidence from an independent study showed that the three properties are contaminated with residual metals from many years of outdoor target shooting and that short- and long-term remediation efforts are needed.

3.7.4 Recreational Facilities

The dominant recreational facilities of Burnaby Mountain Conservation Area include those associated with the Centennial Pavilion area and the trail network (See section 3.8 for more information on recreational use and trails). According to a

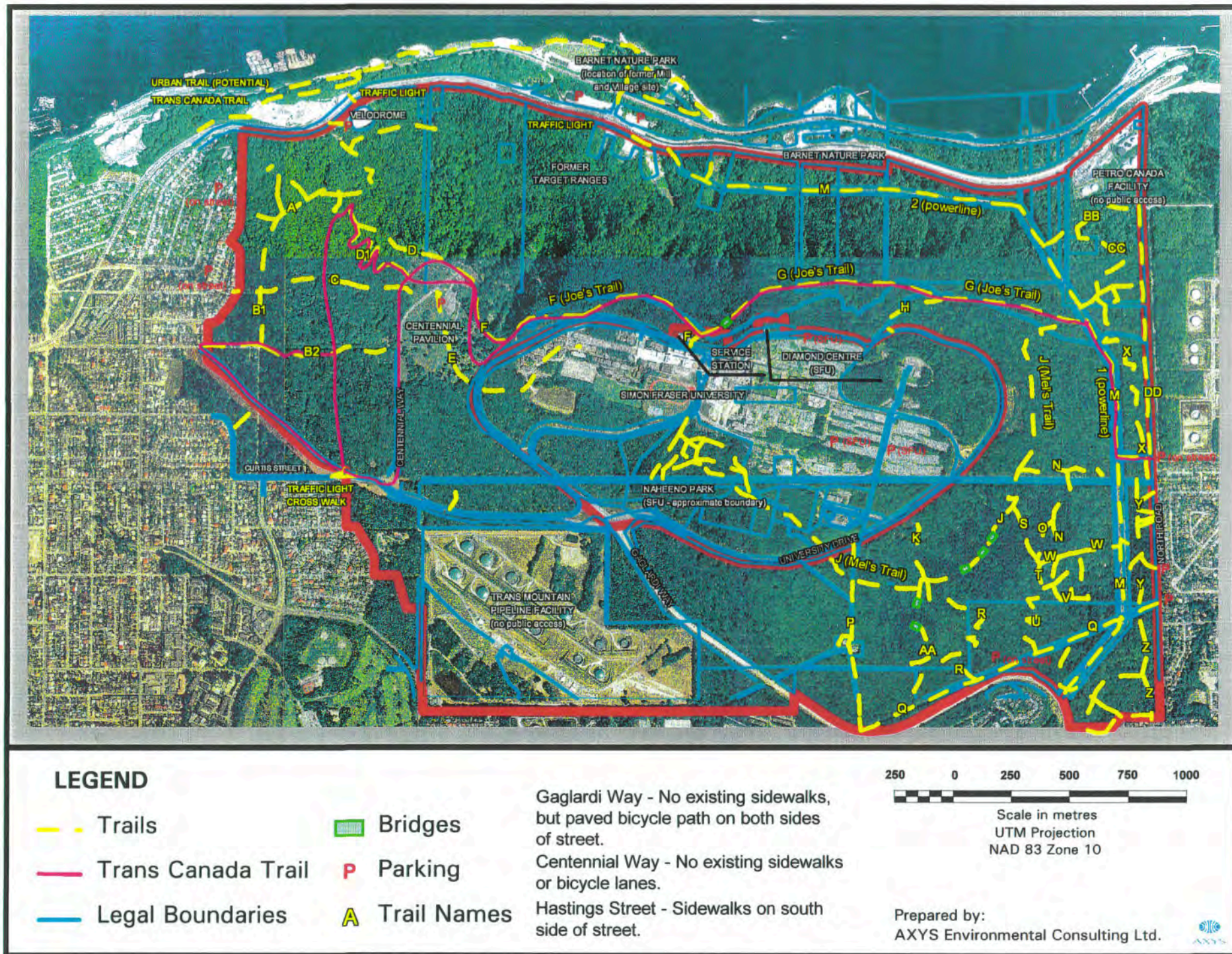


Figure 3-9: Cultural and Recreational Resources in the Burnaby Mountain Conservation Area

questionnaire administered at the first Open House, facilities most used by conservation area visitors are trails, Horizons Restaurant, and the viewing and open grass areas near Centennial Pavilion. There was minimal support from the public for the introduction of new facility developments with the exception of improvements or upgrades to trails. When asked to rate the importance of various resource management issues, virtually all statements relating to the provision of new facilities (i.e., parking, viewpoints, picnic facilities) received ratings of 'unimportant' or 'very unimportant'. Low-key facilities that were thought to be desirable by some participants included trails, washrooms, signs, picnic tables, parking, and bike wash stations (See Appendix C).

Maintenance of facilities will be the responsibility of Burnaby, and maintenance of trails will be a large component of the conservation area's maintenance budget. Most trails will require some level of upgrading and improvements to reduce hazards, drainage problems and erosion. All trails will be upgraded to meet environmental and public safety standards, including appropriate signage, and will be subject to regular monitoring of their condition. Maintaining the trail network will benefit from the assistance of user groups and individuals who report problems and respect proper trail etiquette.

The other important recreational facility in the immediate vicinity of the conservation area is the Harry Jerome Sports Centre (also called the cycle velodrome), which lies immediately south of the Barnet Highway opposite the Kask Brothers site.

3.7.5 Protection of Significant Historical and Cultural Resources

The house from 1912 on the easternmost target range site could be retained for its heritage value provided a suitable use for it is determined. For example, it may be used as an interpretive centre and/or staging place for educational field trips. The house was part of a grouping of buildings in an early settlement on the waterfront and served as the residence for the school teacher. It was moved to its current location in the past and is not officially recognized as a heritage site.

Consideration of the adaptive reuse of the clubhouse should be undertaken in consultation with the Heritage Advisory Committee of the City of Burnaby, particularly if it is intended to be moved to a new location. Its intended use in an educational function may offer an opportunity to reflect its origins as part of a historic school complex. This building also represents the potential to interpret the early settlement history of this area, if considered appropriate within the context of the City's heritage policies.

3.8 Visual Resources

Figure 3-10 indicates the key view opportunities within the conservation area and the management zone for SFU. Burnaby Mountain offers dramatic views from a number of locations throughout the conservation area. Views are one of the key

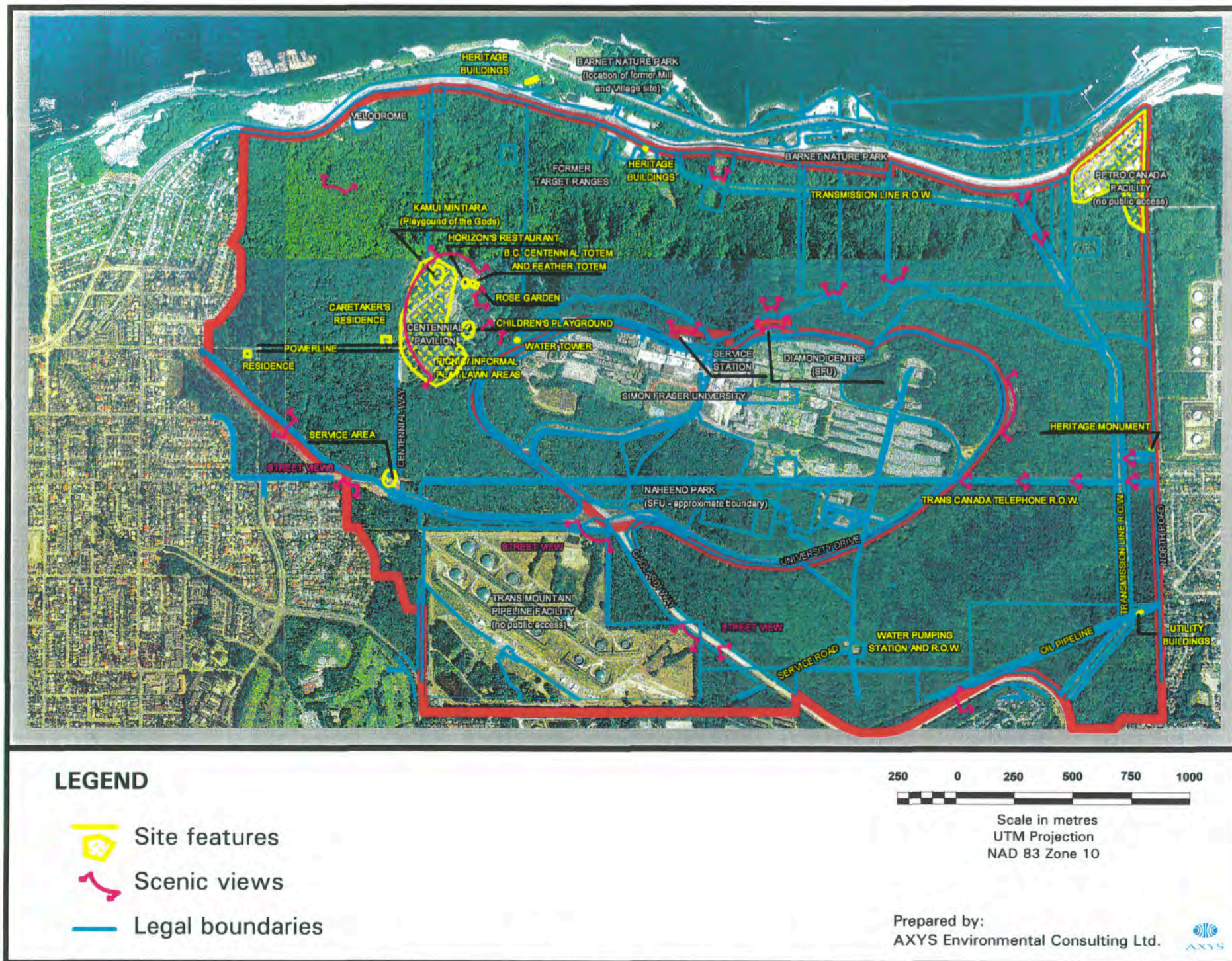


Figure 3-10: Visual Resources in the Burnaby Mountain Conservation Area

attractions of the Centennial Pavilion area site. Depending on the viewpoint location, it is possible to see westward to downtown Vancouver, northward to Belcarra and Indian Arm, eastward to Port Moody, and southward over Burnaby.

Opportunities to enjoy the panoramic views from the mountain are limited by the availability of clearings and elevated vantage points that permit viewers to see above or between stands of trees. Some of the existing available views are likely to be lost over future years in places where the forest is expanding into existing view openings. Many views along Gagliardi Way, from locations within SFU, and from viewpoints along the Ring Road are vulnerable to loss through maturation of the forest cover. Some views are more permanent where they are obtained over the Trans-Mountain Pipeline facility, which will maintain a substantial clearing into the foreseeable future. The new OCP for Simon Fraser University (Burnaby 1996b) identifies a narrow view management area north and parallel to the Ring Road where natural vegetation and trees are to be preserved except as may be necessary to maintain view corridors.

As the surrounding urban communities continue to grow, there may be visual impacts that should be considered. Natural groupings of buffer plantings may lessen the impact of the residential and industrial areas bordering the conservation area.

3.9 Recreation

3.9.1 Opportunities and Use

Burnaby Mountain provides a range of natural environment experiences and forest recreation opportunities such as walking, running, birding, photography and biking. The existing Centennial Pavilion area currently contains a parking, paved walkways and viewpoints, a rose garden, a restaurant and a children's playground.

The area also offers a unique cultural experience with sculptural landmarks, interpretive displays, and two aboriginal totem poles. Because of its natural, recreational and cultural heritage values, the existing Burnaby Mountain Conservation Area is considered a regional visitor destination. Due to its proximity to urban neighbourhoods, the conservation area is also an important recreational resource for nearby communities.

Based on the results of a questionnaire administered at the First Open House, over 75% of respondents stated that they use Burnaby Mountain Conservation Area all seasons of the year. Additionally, most respondents were frequent users of the conservation area; 34.2% of respondents stated they use the conservation area 11 or more times per month while only 14.2% respondents stated they use the conservation area less than once per month.

The three most popular means of arriving at the conservation area were bicycle (38.8%), car (37.7%) and by foot (13.7%) with the most popular access points along North Road (32.5%) and from trailheads at Hastings. The most popular

activities occurring in the conservation area are mountain biking on steep trails followed by hiking or walking, entertaining visitors, and recreational biking.

The dominant recreation resource of Burnaby Mountain Conservation Area is the trail network (See Figure 3-9) which provides access to most of the conservation area except for portions of the north-facing slope above the former target range sites and the steep slopes immediately to the east and west. This trail network, largely built by various volunteer groups, currently provides a variety of trail types from gentle to difficult and supports a variety of trail activities such as walking, hiking, jogging, nature observation, horseback riding, and cycling. Unsurprising, the dominant recreational activity in the conservation area is trail use as indicated in the questionnaire results (Figure 3-11).

3.9.2 The Trail Network

Main trails and their current uses (at the time of plan development) are presented in Table 3-7 while a more detailed description of each trail and its conditions is provided in Appendix F.

Approximately 30 km of trails have been developed on the mountain, with many used on a regular basis by hikers, joggers and mountain bikers. The trail network includes utility corridors, access roads, as well as named recreation trails initiated by various user groups. The City of Burnaby has also recently approved routing the Trans-Canada Trail through Burnaby Mountain Conservation Area. The proposed route will connect Hastings Street on the west to Port Moody on the east. The route currently being proposed for consideration is indicated on Figure 3-9. Some conservation area trails are used to access the university although the steep grades limit the degree of commuter traffic. The conservation area currently provides only a few supporting resources to the recreational use of trails, including public washrooms and parking in the Centennial Pavilion area.

Numerous informal trails also exist, particularly within the mature deciduous forest areas. Some of the trails have quite steep grades and many are built in inappropriate locations. For example, on the south slope of the mountain, there are numerous trails crossing over or through watercourses. Other trails have been created on very steep slopes to provide more challenges for mountain bikers. At least one of these trails (Trail 'S') has been severely eroded by the combined effects of steep grade, poor drainage and intensive recreational use. In such cases, vegetation has little opportunity to reestablish.

3.9.3 Activity Profiles

3.9.3.1 Pedestrian Use

Pedestrians use the conservation area for a number of activities including trail-based activities (i.e., walking, hiking, jogging), scenic viewing, photography, nature study, cultural appreciation, picnicking and sightseeing. Pedestrians have historically had access to all trails on Burnaby Mountain and are the dominant users of the

Table 3-6. Main Trails and Current Trail Uses within the Burnaby Mountain Conservation Area

| <i>Trail</i> | <i>Recreational Walking Use</i> | <i>Hiking/ Jogging Use</i> | <i>Commuter / Recreational Mountain Bike Use</i> | <i>Technical Mountain Bike Use</i> |
|-----------------|---------------------------------|----------------------------|--------------------------------------------------|------------------------------------|
| A | Y | | | Y |
| B1 | Y | | Y | |
| B2 ¹ | Y | | | Y |
| C | Y | | | Y |
| D | Y | | | Y |
| D1 | Y | | | Y |
| D2 | | Y | | |
| E | Y | | Y | |
| F ¹ | Y | | Y | |
| G ¹ | Y | | Y | |
| H | | Y | | Y |
| I | Y | | Y | Y |
| J | Y | | Y | |
| K | | Y | | Y |
| L | | | | |
| M1 | Y | | Y | |
| M2 | Y | | Y | |
| N, O, V | | Y | | Y |
| P | Y | | Y | |
| Q | Y | | Y | |
| R | | Y | | Y |
| S | | Y | | Y |
| T | | Y | | Y |
| U | | Y | | Y |
| W | Y | | Y | |
| X | Y | | | Y |
| Y | Y | | | Y |
| Z | | Y | | Y |
| AA | | Y | | Y |
| BB | | Y | | Y |
| CC | | Y | | Y |
| DD | Y | | Y | |

Notes:

- 1 To be designated as part of the Trans-Canada Trail
- 2 Note all trails are also used for various forms of passive recreation such as nature appreciation, photography and sightseeing.

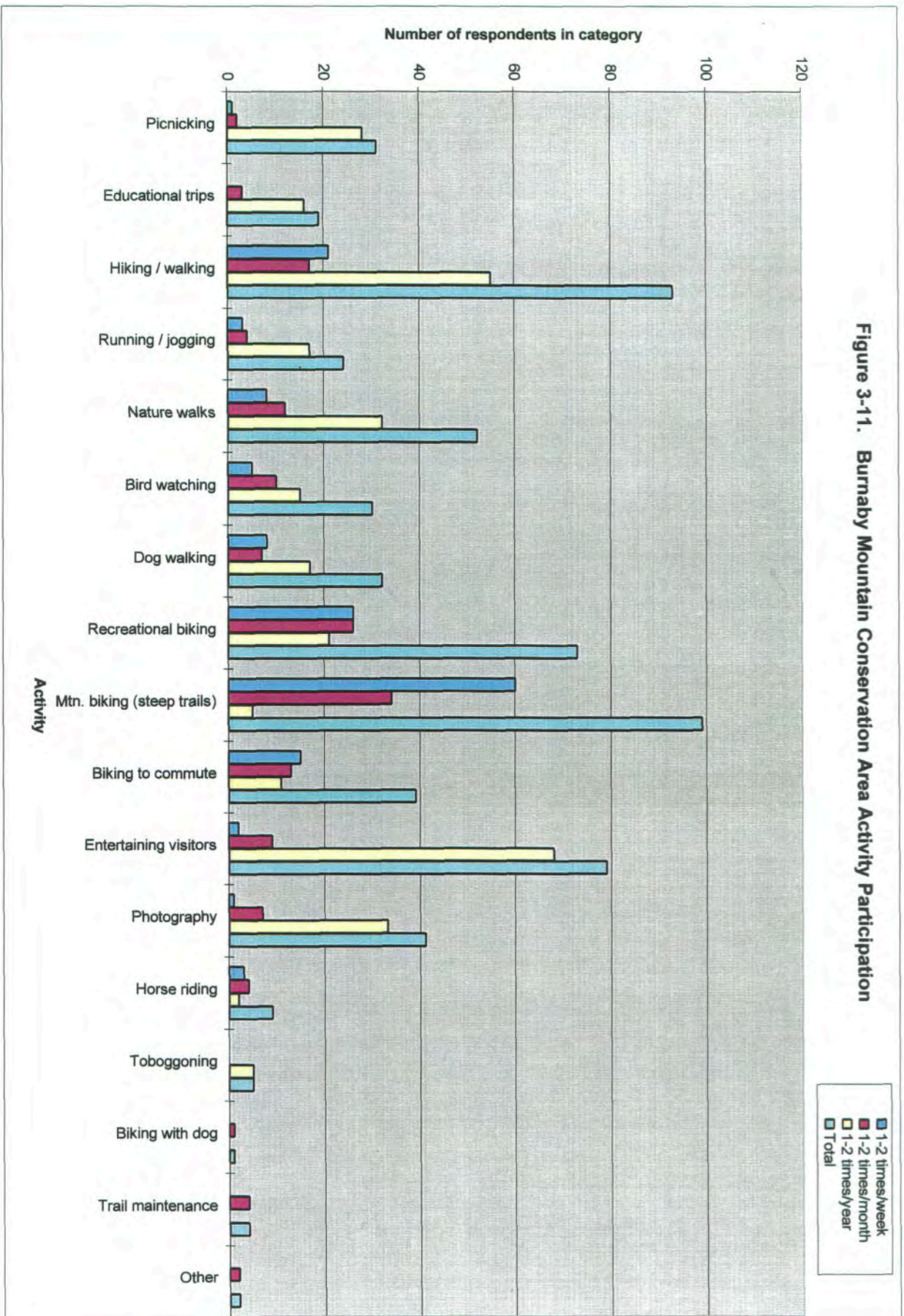


Figure 3-11. Burnaby Mountain Conservation Area Activity Participation

Centennial Pavilion area. While recent conservation area issues have focused on the impacts of mountain biking on trails, it is recognized that pedestrian use can also have environmental effects that may warrant management actions. Off-trail hiking is one of the more significant issues (see Section 3.3.5.1). Other issues include soil compaction, root exposure, damage to watercourses as a result of sedimentation and trampling of riparian vegetation (mainly attributed to inadequate crossings).

3.9.3.2 Mountain Biking

In the past decade, and as evidenced by site observations and Open House results, cycling has become the dominant recreational activity on Burnaby Mountain for a wide range of age groups and families. It is an activity providing strong opportunities for the youth. The 1996 Community Needs and Preferences Study reported that cycling is a popular and growing activity. Approximately 43% of Burnaby residents ride cycles.

While cycling has historically been prohibited on Burnaby Mountain, the mountain has continued to receive high levels of recreational cycle use. Additionally, cycling has become a very popular way to commute or to exercise for students and residents of the expanding campus of SFU. Cycling is now approved for Burnaby Mountain Conservation Area along the Trans-Canada Trail route which traverses the entire north-central portion of the conservation area (The Trans-Canada Trail is intended for pedestrian and cycle use).

Cyclists in the conservation area represent a range of biking activities from SFU students who commute to the campus from nearby residential areas to organized mountain biking groups who ride more challenging trails for recreation and skill development. For the purposes of this plan these types of biking are classified as "Commuter" or "Recreational" cycling and "Intermediate Mountain Biking". Due to its designation as an ESA and the nature of the geography and terrain of the conservation area, Burnaby Mountain is not considered an appropriate location for "Extreme" mountain biking, that is, mountain biking which uses very steep trails with multiple technical challenges (e.g., drops, jumps). Extreme mountain biking is better suited to higher mountain areas with considerably longer slopes and topographic diversity, and with less concern for the preservation of forest habitat. However, Burnaby Mountain Conservation Area, by way of its size and topography, provides a setting able to accommodate recreational to intermediate cycling and mountain biking.

Mountain bikes, when concentrated in unmanaged areas, can create accelerated soil compaction or erosion with associated vegetation loss. On Burnaby Mountain, there is evidence of trail damage and damage to creek beds caused by mountain bikes, e.g., erosion, puddles, vegetation trampling, and root exposure. However, a cycle trail on appropriate soils, with proper drainage and management can function well as a cycle route. On Burnaby Mountain, while there are individual trails of concern, many trails in the system are located in suitable areas and can accommodate recreational and intermediate cycling with minor to moderate upgrading and regular maintenance. The creation of longer loop trails would also benefit cyclists by

providing a more challenging workout. The Burnaby Mountain Bike Club has also requested that Burnaby consider designating a small area of the conservation area for skills training aimed at younger, less-experienced cyclists but which may also include some challenges for more technical riders.

3.9.3.3 Equestrian Use

Existing policy of the Parks and Recreation Commission (adopted in 1992) states that all equestrian trail development be confined to municipal park within the Burnaby Lake Regional Park and Sports Complex. However, the BHA has requested expanded trail opportunities within Burnaby Mountain Conservation Area in recognition of their historic use of the mountain.

Horse use on some trails on Burnaby Mountain is presently occurring and information provided by the Burnaby Horseman's Association (BHA) has indicated that equestrians have been riding Burnaby Mountain trails for many decades. The exact number of equestrians is not known although numbers are believed to be less than 15 regular riders, mostly from the BHA. Equestrians access Burnaby Mountain by riding from their facility within Burnaby Lake Regional Nature Park along an unsanctioned route that uses city roads and rail lines to connect to existing trails from Beaverbrook Crescent to Burnaby Mountain. Once inside at the mountain, their preferred route is via North Road, and up the Trans-Canada Trail to the Centennial Pavilion.

Although the current access route from Burnaby Lake to Burnaby Mountain is used by equestrians is unlikely to be sanctioned in the future, it is recognized the horse use on Burnaby Mountain is appropriate along certain wide trails that can accommodate multiple user groups. Additionally, the area of the former target ranges could potentially provide parking opportunities to accommodate occasional horse and trailer destination use to the conservation area (although this is not expected to be a significant use). However, many trails cannot function as equestrian trails due to steep slopes, sharp corners and insufficient width.

3.9.3.4 Off-Leash Dogs

Experience from other parks has shown that dogs off their leashes can be disturbing to some visitors and to wildlife. The presence of off-leash dogs on conservation area trails and within the Centennial Pavilion area has been identified as a concern. Off-leash dogs can potentially result in impacts including:

- disturbance to ground-nesting birds either through nest disturbance/destruction or direct kills;
- disturbance to stream habitat caused by dogs running through or crossing streams;
- sensory disturbance to deer;
- disturbance, stress, or direct mortality of other wildlife, such as small mammals; and
- social issues such as conflicts with other users, noise, clean-up.

Due to these issues, the management planning process has determined that off-leash dogs are not compatible with the conservation objectives of the conservation area.

3.9.3.5 Other Uses of the Conservation Area

Other conservation area uses include nature study and appreciation, bird watching, picnicking, scenic viewing, flying kites, and winter activities such as tobogganing. The Centennial Pavilion area is also frequently used as a tourist stop for larger groups who arrive at the by bus.

3.9.4 User Conflicts

User conflicts in Burnaby Mountain Conservation Area are primarily centred around the use of trails. Information from the public and from site visits showed that the highest used trails for mountain biking are the same trails most used by hikers. These are Joe's Trail ('G'), Cardiac Hill ('H'), Mel's Trail ('J'), Perimeter Trail ('F', 'G', 'H') and the Powerline right-of-way ('M1', 'M2')². During public consultation meetings, mountain bikers requested that all trails presently used by cyclists be designated multi-use trails. Other interest groups have acknowledged a place for cycling activities, but have not openly accepted the concept of multi-use trails *for all trails*. They would like to see a number of trails designated for pedestrian use only.

In recognition of the damage biking can do, the Burnaby Mountain Bike Club (BMBC) has undertaken some volunteer trail maintenance (against the current regulations of the City of Burnaby). However, conflicts with other users have arisen due to noise, crowding, trail damage and perceived threats to personal safety. Enforcement of mountain bike etiquette will be challenging, largely attributable to the fact that the mountain has been unmanaged for so many years. However, there are organized groups such as the BMBC that are willing to promote proper trail etiquette and assist Burnaby with the policing of conservation area trails.

The only other significant conflict that was identified relates to off-leash dogs both along trails and within the Centennial Pavilion area. In addition to their effect on ecological resources, some users do not care to have off-leash dogs in Burnaby Mountain Conservation Area. The City of Burnaby has established several off-leash dog sites in nearby areas including Barnet Marine Park, which can be used seasonally from October to March.

² Trail names have derived from many sources. Some trails, such as Joe's and Mel's were named for past creators or users, other names are more recent and many trails have been named by the BMBC. While some trail names have become commonly used among all types of users, to avoid confusion, letter-names have been assigned for the purpose of the Management Plan. Eventually, all trails should be officially named by the Parks and Recreation Commission.

3.9.5 Impacts of Increased Use of the Conservation Area

Trail use for mountain biking and hiking is the most commonly conducted activities on Burnaby Mountain. Trail use is expected to increase as the residential communities of SFU and Burnaby grow and as the trail system becomes more formalized. Environmental issues of increased trail use include erosion problems, soil compaction, off-trail hiking, removal of vegetation, and disturbance to wildlife. Trail development and maintenance must consider the environmental impacts caused by trail construction and use, and the implications of providing access to more ecologically sensitive areas. In particular, trail activities around streams can alter natural stream processes and affect the quality of stream habitat.

3.9.6 Access

Issues associated with improving access include: increased vehicle traffic on the mountain; greater potential for collisions with wildlife; and habitat loss or fragmentation due to the addition of trails, viewpoints or parking lots. Means of improving access include the provision of trailheads, viewpoints, vehicle turn-offs and parking lots. Access could also be improved simply by providing directional signage or maps that direct visitors to use different parts of the conservation area. The provision of additional parking within the conservation area is believed to be relatively unimportant to most users³. However, the current number of parking spaces at the Centennial Pavilion is not sufficient or not appropriately located to meet all existing demands for parking, particularly for access from the base of the mountain. Given that use of the conservation area is expected to grow, options for increased parking either within or outside of the conservation area must be considered.

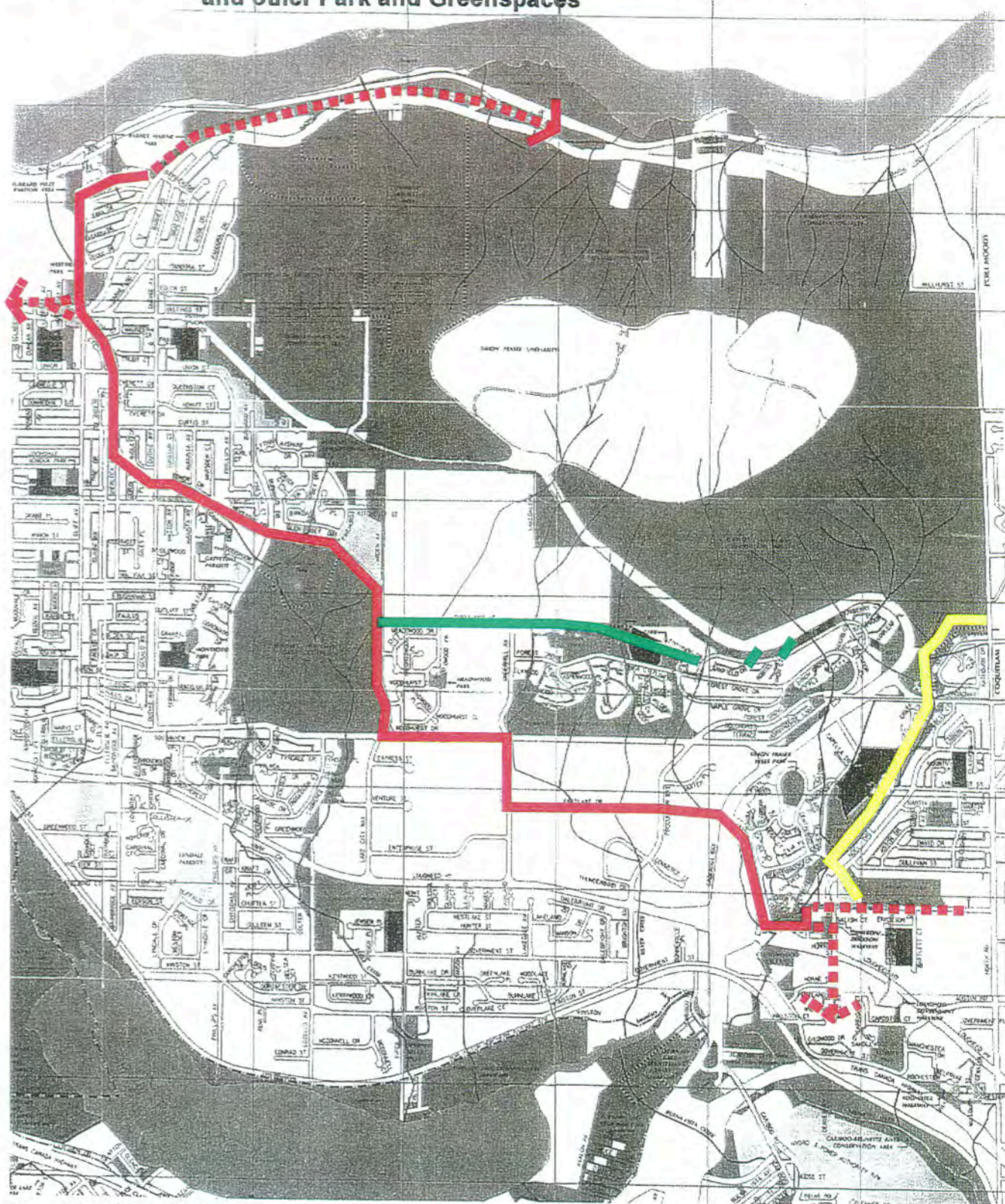
3.9.7 Links to Other Parks and Greenspaces

The greater Burnaby area has many parks and natural areas. Burnaby Mountain Conservation Area, together with Barnet Marine Park, Deer Lake Park, Burnaby Lake Regional Park, Burnaby Mountain Golf Course and a number of neighbourhood parks and conservation areas, offer a wide range of recreational opportunities and serve as important corridors for wildlife movement. A network of trails and cycle routes within the surrounding residential neighbourhoods connect with Burnaby Mountain and a number of opportunities to enhance trail linkages have been identified. These include improved integration into the City's Urban Trails Network (see Figure 3-12), for example:

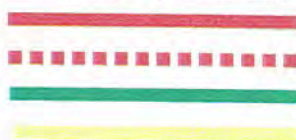
- improving connections to Barnet Marine Park and the proposed Urban Trail on the north side of Barnet Highway. Effectively linking these two park areas can offer benefits from shared parking and other facilities and improved pedestrian

³ As part of the First Open House Questionnaire, respondents were asked to rate various resource management issues from 1 = very important to 5 = very unimportant. Providing vehicle accessible viewpoints was given an average rating of 4.26 which was the highest score (but least important) of all items presented. Providing parking at trailheads also ranked as relatively unimportant with an average score of 3.24.

Figure 3-12: Linkages between Burnaby Mountain Conservation Area and other Park and Greenspaces



Burnaby Mountain Urban Trail
Proposed Urban Trail
Informal Trail
GVRD Service Road



- and cyclist access to the waterfront from neighbourhoods to the east and south of Burnaby Mountain Conservation Area.
- implementation of the Trans-Canada Trail through the conservation area will provide enhanced connections to the west and east for Burnaby and Port Moody residents and will attract greater numbers of destination trail users.
- an Urban Trail is partially in place near the southern boundary of the conservation area. Future implementation of a pedestrian/cycle path linking the Trans-Mountain Trail with the Oil Pipeline Trail will permit neighbouring residents to move into the conservation area on foot or bicycle via improved connections to the Stoney Creek Trail.
- planned sections of the Stoney Creek Trail will eventually achieve stronger connections to the neighbourhood immediately west of the Lougheed Mall.
- planned upgrading and interpretation of the North Road Heritage Trail will add an improved access option for neighbours to the east of the conservation area, in combination with the Trans-Canada Trail.

Providing linkages to other natural areas and to residential communities is an important objective. The City of Burnaby has taken steps to adopt an Urban Trails System that will link Burnaby Mountain to other parks and greenspaces. Trail design for Burnaby Mountain Conservation Area should consider these potential linkages. In addition, as the size of the SFU community grows, it will be important to provide safe access routes between the campus and the conservation area.

3.10 Education and Interpretation

Interpretation of the resources and facilities within the conservation area is currently limited to the area within and immediately around the Centennial Pavilion area and to the heritage cairn at the north end of North Road. Some signage along trails has been erected since Burnaby acquired the parklands, however, most trails are not signed. Providing appropriate signage and maps can serve many conservation area objectives including interpretation, safety and access. Signs have been used effectively in other parks and conservation areas to denote trail usage, and to educate visitors on rules and appropriate visitor behaviour. Interpretive signs or kiosks could also provide information to visitors on natural and cultural features. These signs and displays must be in keeping with the natural character of the conservation area, which was an issue of sensitivity expressed by some members of the public who attended the Open Houses.

There is currently very little educational interpretation within the conservation area. The Burnaby Mountain Preservation Society has developed several self-guided interpretive walks along trails within the conservation area. However, these brochures are not readily available to most visitors. There are, however, ample

opportunities to provide educational information to visitors in a subtle and sensitive manner. A small nature interpretation centre, self-guided nature walks, and bird blinds are ideas that have been proposed to increase the range of educational experiences available in the conservation area.

3.11 Research and Monitoring

Based on a review of existing information and discussions with the City of Burnaby and other agencies, a number of key areas were identified which would benefit from additional research and monitoring activities.

First, the paucity of wildlife information for Burnaby Mountain requires further surveys to be conducted. These surveys should be conducted at appropriate seasonal periods, corresponding to those recommended by the Resource Inventory Committee for Biodiversity in British Columbia. In consideration of data short-falls, the planning and design of the conservation area must take a conservative approach in favour of habitat protection.

Secondly, information on potential and resident fish and other aquatic species within the water bodies of the conservation area has been gathered from previous reports (i.e., stream surveys, inventories and impact assessments). This exercise provided a good overview of all waterways on Burnaby Mountain. However, fish sampling was not conducted as it was felt that an appropriate level of data could be gathered from existing reports and communications with knowledgeable staff and community members. Future work by environmental groups and streamkeeper organizations may be used to supplement existing data.

Finally, no firm data exist on the level of recreational use of Burnaby Mountain. Additionally, there is very little information with respect to visitor experiences other than that gathered as part of this study.

3.12 Conservation Area Administration

Since the transfer of SFU lands to the City of Burnaby, administrative responsibility for Burnaby Mountain Conservation Area has been given to the Burnaby Parks, Recreation and Cultural Services Department. It is intended that the new administrative structure will be in keeping with existing structure, policies and operations for Burnaby parks, and will become part of the Department's overall management scheme.

There are site-specific issues that are pertinent to Burnaby Mountain Conservation Area and that will need to be addressed as part of the Management Plan. City staff have expressed some concern regarding liability in the event that a visitor is injured. Hazards include steep terrain, collisions on trails, vehicle traffic, and personal safety and security issues associated with forest trails. As Burnaby accepts this responsibility in other parks, it is expected that similar measures will be taken on Burnaby Mountain to address liability issues. Signs have already been posted along

some trails within the conservation area. In addition, the Concept Plan will utilize trail designs or improvements that may reduce the risk of liability (e.g., trail closures, use designations and restrictions, installing speed control barriers for mountain bikes).

Additionally, within the conservation area boundary there are 112 hectares of privately held land. This includes utility rights-of-way, transportation rights-of-way, petroleum storage facilities, and several small residential parcels not yet acquired by the City. The Harry Jerome Sports Centre is also contained within the outer conservation area boundary. These landowners and leaseholders have recognized legal rights (e.g., access, vegetation management) which must be recognized in the Management Plan and any future decisions that may affect their operations and use. Private inholdings (i.e., residential properties) should be acquired as they become available as part of the City's land acquisition program.

Burnaby and SFU have also discussed the possibility of incorporating the existing Naheeno Park as municipal parkland. Naheeno Park, located within the SFU Ring Road, is currently recognized as separate from Burnaby Mountain Conservation Area. It contains community gardens and recreational trails that provide access and linkages between Burnaby Mountain Conservation Area and the SFU campus. Naheeno Park has been identified in the SFU OCP as the most ecologically significant area within the Ring Road, and is to be maintained as a natural undeveloped park area. If Naheeno Park is turned over to the City of Burnaby, its status in connection to Burnaby Mountain Conservation Area will have to be determined.

Finally, a reality of conservation area management is how to pay for services offered. Some suggestions have arisen from public consultation including the need to explore partnership opportunities with community groups, associations, recreation clubs and local industry. Pay parking is also an option, however, this may be difficult to implement.

3.13 Regional and Community Cooperation

3.13.1 Community Outreach

Given the high profile of Burnaby Mountain Conservation Area, and the variety of land uses occurring within the conservation area and surrounding area, it will be critical to maintain a high level of public involvement throughout all phases of the planning and implementation process. Ideas for creating awareness and providing educational opportunities include: creation of streamkeepers or trailkeepers programs; creation of a "Friends of Burnaby Mountain" committee; encouragement of students and professors to undertake research projects on the mountain; implementation of volunteer bird survey programs or nest box programs; and encouragement of greater use of the mountain for school field trips.

3.13.2 Cooperation with SFU

Simon Fraser University, located on top of the mountain, is circumscribed by University Drive (the "Ring Road") which forms the boundary between the campus and the conservation area. SFU, with the City of Burnaby, has completed its Official Community Plan (OCP) which was adopted by Council September 9, 1996. SFU plans to develop more of the existing campus within the Ring Road to meet the growing demand for student housing, facilities and services, as well as to provide market housing. The addition of a potential maximum of 4500 units of market housing are planned which could have implications on the carrying capacity of the mountain and on the environment of the surrounding conservation area. The OCP also includes an expansion of the existing campus and the potential for a variety of uses for the broader community.

Some members of the public have expressed concern over the environmental damage that could be caused by large-scale development on Burnaby Mountain. Of particular concern were the impacts of stormwater runoff and construction-related sedimentation on local creeks and streams. Several environmental safeguards are written into the OCP for SFU, including tree retention provisions, adherence to stream stewardship principles, and voluntary compliance with Burnaby's ESA guidelines. The City of Burnaby should ensure that these policies are emphasized and enforced with consideration of the potential effects of SFU's activities on the conservation area environments.

In addition to stormwater management, the increase in the university's residential population is expected to result in more use of Burnaby Mountain Conservation Area by campus residents. This will create pressure on the existing trail system and may, over the long-term, result in greater demand for recreational facilities and opportunities. There are also concerns that the expanded campus will eventually require infrastructure upgrades that will have implications on the conservation area environment, for example, additional roads to access the campus or new utility corridors to meet growing service demands.

3.13.3 Cooperation with Landowners and Lease Holders

In addition to recreation and conservation, the conservation area currently supports a number of other land uses. Within the conservation area boundary there is an additional 112 hectares of privately held land that includes utility rights-of-way that bisect the forest, and petroleum storage facilities located at the base of the mountain. There are also some private residential properties to be acquired in the future. The Harry Jerome Sports Centre is situated at the north boundary of the conservation area adjacent to the Barnet Highway. This building contains a cycle velodrome and multi-sports facility. The Burnaby Mountain Parkway, a major transportation corridor, passes through the conservation area servicing traffic to the Centennial Pavilion area and SFU, as well as Hastings Street and the Lougheed Highway.

Residential and industrial developments surround the conservation area on the east, south and west sides. Steep slopes and unstable terrain have made the north side less suitable for development. The Barnet Highway delineates the north boundary of the conservation area and the Canadian Pacific Railway mainline located below the highway parallels the shoreline of Burrard Inlet. Further urban growth is expected in the community as the Lougheed Town Centre and the Lougheed Highway corridor accommodate increased population densities and a planned rapid transit line.

Access points and service roads to utility corridors within the conservation area will have to be formalized and maintained. B.C. Hydro has requested assurances that future developments within the conservation area do not block access to utilities for maintenance purposes (i.e., repairs or tree trimmings around lines). SFU's past experience has shown that moving vehicles or equipment to service utilities can cause environmental damage especially where routes are not well maintained. Potential expansion of private utilities in the conservation area may be an issue although no companies have come forward with such plans. Permission will also be required by the City of Burnaby to provide public access along utility corridors, especially the B.C. Hydro right-of-way (Trail 'M') which is not currently passable along its entire length.

