Appendix 3 : Geology, Soils and Climate of the Avalon Peninsula

Geology

The Avalon Peninsula is commonly described physiographically as an area of rolling uplands interspersed with small plateaux. Uplands extending up to about 300 m ASL, and rarely over 400 m ASL, characterize the Bay de Verde, and St. John=s Peninsulas, and the Cape Shore and southern Avalon areas. Plateaux between 100 and 150 m ASL are common in some parts of the Avalon Peninsula, particularly the southern Avalon. These areas have previously been described as erosional surfaces or peneplains (Twenhofel and MacClintock 1940). The largest area of lowland extends northward from St. Mary’s Bay. The relationship between bedrock geology and physiography is highlighted by the numerous northeast to north-northeast alignment of many of the coastal fjords, particularly on the western side of Conception Bay. This direction is consistent with the axes of major folds and faults.

Considering bedrock geology, the eastern Avalon Peninsula is underlain by a succession of late Precambrian volcanic and plutonic rocks that are exposed in an anticlinal dome, which extends southward from Conception Bay. These are the oldest rocks in the area. They are overlain on all sides by successively younger, marine, deltaic and fluvial sedimentary rocks. In the western Avalon Peninsula, younger, late Precambrian volcanic rocks occur immediately below and within the fluvial sedimentary units. A less extensive suite of latest Precambrian plutons locally intrude the volcanic and marine sedimentary assemblages.

Cambrian to earliest Ordovician shales, limestones, sandstones and rare volcanic flows are preserved in outliers in several areas of the Avalon Peninsula. They rest unconformably on different parts of the late Precambrian stratified succession and on plutonic rocks.

Early Silurian and Devonian mafic intrusions are emplaced into Cambrian rocks in the southwestern part of the Avalon Peninsula and represent the youngest exposed rocks in this part of the Avalon Zone.

Considering Quaternary geology, it is likely that the Avalon Peninsula was completely glaciated during the last glacial period, and maintained glacier cover until around 9000 years BP. The pattern of ice flow is complicated. There was a main dispersal centre at the head of St. Mary=s Bay which flowed radially outward. However, the spines of the sub-peninsulas also maintained independent glaciers from which flow was also radial. These smaller centres became dominant as the main ice cap melted. The pattern of ice flow is shown by glacial striae on rock surfaces.

Glacial sediment is generally thin across the Avalon Peninsula and composed of locally derived material. Thicker sediment is found north of St. Mary=s Bay. It commonly takes the form of parallel ridges of sediment aligned perpendicular to the last direction of ice flow. These Rogen moraines were formed at the base of a glacier moving northward towards Conception Bay. Areas of glaciofluvial sand and gravel are found within many of the major valleys, although sediment is commonly thin.

Surficial geology maps for the Avalon Peninsula are available at 1:250 000 and 1:50 000 scales and a detailed discussion of the surficial geology of the Avalon Peninsula in Henderson (1972).

Soils

Most of the existing soils on the Avalon Peninsula are derived from glacial and fluvoglacial deposits from the last glaciation. Organic deposits, shore deposits, and tracts of alluvium along streams compose the remaining soil building parent material. Steepness of slope largely determines susceptibility to erosion. These conditions have combined to produce soils of a wide variety of fertility.

Under cool, humid climatic conditions mineral soils produced from local parent materials are stony podzols which are generally thin, full of fresh rock fragments, and strongly acidic. Often they are of low fertility with a gray leached top layer and yellow brown subsoil. Widespread accumulations of vegetative matter in various stages of decomposition form soils of muck and peat. The soils of the Avalon have been mapped and classified into forty-three different soil series (Herringa 1981).

Climate and Climate Change

The Management District lies at the Southeast corner of the Province generally between 46^{o} 35' and 48^{o} 10' latitude and 52^{o} 40' and 54^{o} 15' longitude. The climate is typically maritime with temperature extremes moderated by the surrounding ocean. Mean summer (JJA) temperatures are 12 - 14^{o} C with winter (DJF) temperatures averaging -4^{o} C. Precipitation ranges from 1100 to 1600 mm and is well distributed throughout the year. Potential evapotranspiration is 475 to 500 mm per year. Frost free days on the Avalon range from 100 to 160 per year and the vegetative growing season (summation of degrees above 5^{o} C each day) is 900 to 1200 per year. These summary data are based on the 1961-90 period of climatic Anormals@, which is the averaging period in current use in Canada. Such averages do not reflect interannual and decadal-scale variability. For example, winter snowcover on the Avalon is highly variable and this has effects on streamflow, soil moisture and soil temperature. Nor do the data reflect trends or recent extremes. Globally, the decade of the 1990s was the warmest in over a century. On the other hand, warming over northeastern Canada and the northwest Atlantic over the past 5 decades was less than occurred in central and western regions, a pattern that will likely persist.

Climate change studies reported by the Intergovernmental Panel on Climate Change (IPCC) provide strong and convincing evidence of global climate change as a result of human activities. Increased levels of greenhouse gases are projected to cause warming through the end of the century, particularly in middle and high latitudes, with winter and nighttime temperatures increasing the most. Precipitation is generally expected to increase in middle and high latitudes, but increased evapotranspiration will mean lower soil moisture in most areas of the continent. Variability and extremes of weather events, such as winter storms and tropical cyclones, are expected to increase. Impacts on boreal forests in general are expected to be significant as reported below (IPCC, 1996);

- Impacts of anthropogenic climate change are likely to be greater on boreal forests than temperate and tropical forests.
- An increase in fire frequency and pest outbreaks is likely, resulting in decreasing average age, biomass, and carbon store.
- At its southern boundary, boreal coniferous forest is likely to give way to temperate zone pioneer species or grasslands.
- Northern and altitudinal forest limits are likely to advance slowly into areas occupied by tundra.
- Where water is not limiting, net primary productivity is likely to increase in response to warming, partly mediated by increased nitrogen mineralization.
- There may be a net loss of carbon from the ecosystem because of associated increases in soil organic matter decomposition.

To go much beyond such general statements would require a level of precision that climate models do not have. Likely scenarios could be applied to the region including past experience and knowledge of the local climate and climate-forest relations. Tentative scenarios could include;

- increasing year to year variability in snow fall
- possible longer dry periods in the summer
- likely more frequent blowdown events

There is uncertainty in climate models and a high probability for disruptions to the current forest ecology over the next few decades.