T3.2 ANCIENT DRAINAGE PATTERNS

The drainage patterns across Nova Scotia have developed almost entirely since the Tertiary and are closely tied to the geology. They are the response of water flowing down an inclined plain to the structure and composition of the underlying rocks. Water follows lines of weakness, such as soft strata, joints or faults, and establishes a characteristic drainage pattern. This is modified until the river develops a profile which is in equilibrium with the regional slope, precipitation and the geology of its drainage basin.

In Nova Scotia, drainage patterns diverge from their ideal form because of three influences: the Pleistocene glaciation, which scoured the surface of the province and then dumped unsorted rock debris upon it; fluctuations in sea level; and ancient river channels, which developed before the Tertiary and are now superimposed upon the terrain. All these factors are reviewed in more detail below.

ROCK TYPE

Potential for erosion, permeability and jointing of the bedrock determine both the proportion of water that is retained on the surface and how runoff is channelled. Impermeable, poorly jointed rocks ,such as granite, greywacke and slate, retain most of the water on the surface in a disorganized series of streams, lakes and bogs. This is called deranged drainage and can be seen on the South Mountain and across most of southern Nova Scotia (mainly in Region 400) (see Figure T3.2.1).

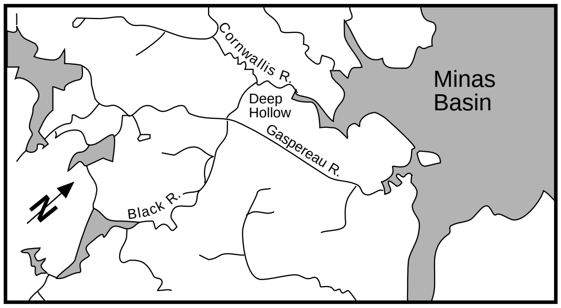

Figure T3.2.1: Deranged drainage. The Black River formerly drained through Deep Hollow into the Cornwallis River and is an example of river capture (see Figure T3.2.6). The more vigorous Gaspereau River has diverted the Black River at White Rock. Black River, in Region 400, is a deranged drainage pattern, now extensively dammed for hydro-electric power.

Permeable, well-jointed rocks, such as limestone, sandstone and gypsum, allow substantial infiltration, have few lakes, and channel surface runoff along joint lines and the bedding trend. The product is rectangular or trellised drainage (see Figure T3.2.2). This is well developed in the Carboniferous sandstones and salts of central and northern mainland Nova Scotia and Cape Breton (mainly in Region 500).

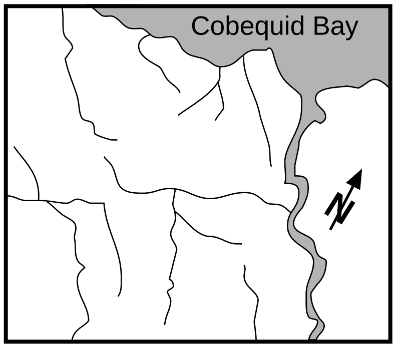

Figure T3.2.2: Trellis drainage, East Hants Co., District 510.

Dendritic drainage patterns develop on unconsolidated sediments with an even slope and on evenly resistant rocks with moderate to high relief. This is exhibited by the soft Triassic sediments in the Annapolis Valley (District 610), around the Minas Basin (Unit 913b), in Regions 600 and 700, and in the highland areas of the Cobequids, Pictou–Antigonish and Cape Breton in Region 300 (see Figure T3.2.3).

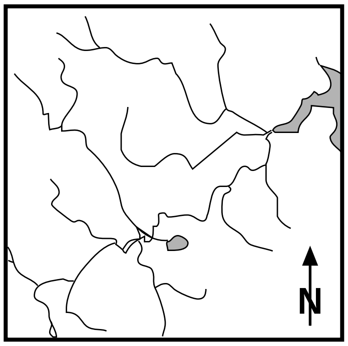

Figure T3.2.3: Dendritic drainage, West River, Antigonish Co. (Units 312 and 583a).

T3.2
Ancient
Drainage
Patterns

STRUCTURE AND SLOPE

In tilted or folded strata, where hard and soft rocks are interbedded, fluvial erosion tends to produce a ridge-and-valley topography. The valleys, and therefore the streams that flow in them, are parallel to one another. If the regional slope of the land surface is parallel to the axes of the folds, a parallel drainage pattern may develop, becoming rectangular in places where the ridges are crosscut. If the fold and slope directions are opposed, the pattern is generally strongly rectangular, or even trellised. While there are no good examples of this type of parallel drainage in Nova Scotia, structurally controlled rectangular patterns are well developed on the Northumberland Plain (Unit 521a), north and east of the Cobequid Hills.

Faults also add a linearity to drainage patterns, since the rubbly material along their zone of movement is easily removed by flowing water. This fault control is a feature of the West River St. Marys (Unit 572) and several nearby river valleys; for example, Tangier River (Units 453/834) and West Sheet Harbour River (Unit 413b) in Halifax County.

Parallel drainage is also characteristic of areas where streams cascade down a steep slope and do not branch appreciably before entering the sea; for example, the streams rising on North Mountain (District 720) and flowing down to the Bay of Fundy (see Figure T3.2.4).

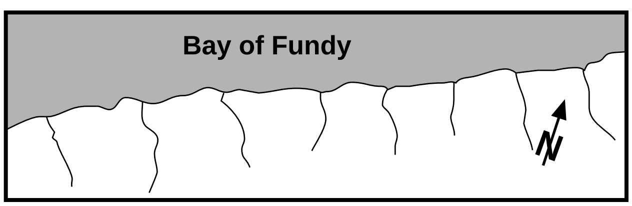

Figure T3.2.4: Parallel drainage, North Mountain, District 720.

When the highland area is rounded, the streams drain down the slopes in a radial pattern. The Cape Breton Highlands (Region 200) and Mabou Highlands (Region 300) both exhibit a modified radial-drainage pattern (see Figure T3.2.5).

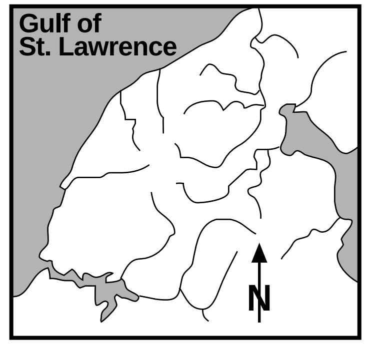

Figure T3.2.5: Radial drainage, Mabou Highlands, Unit 314.

ICE SCOURING

The scouring action of ice overprints a lineation on the bedrock, which is parallel to the direction of ice flow. This linearity may change the drainage pattern locally and override the control normally imposed by the bedrock. In Nova Scotia, this influence is locally manifest in the alteration of a dendritic pattern to one approaching parallel or rectangular; for example, along the western shore and eastern shore of the Atlantic coast (Region 800), and in southern Cape Breton.

DEPOSITION

In contrast to the linearity imposed by scouring, glacial deposits tend to block established channels and disorganize the drainage patterns. If the deposits had an even thickness and distribution, a dendritic pattern might be established. However, in Nova Scotia, glacial deposits tend to be very uneven and the drainage is deranged. The influence of glacial deposits is well displayed in southern Cape Breton, where thick glacial deposits on the flat bedrock have established a new regional slope. The Mira River, which once flowed southwards, now flows eastwards (Unit 870).

SEA-LEVEL CHANGE

In a stable environment, rivers and streams establish a concave profile from source to mouth, which is in equilibrium with the relief, geology and distance from the headwaters to the estuary. The profile is

Plate T3.2.1: Folly Gap, looking south; an ancient river valley modified by glacial actions (Units 311 and 521a). Photo: R.Lloyd

established above a "base level," which is ultimately sea level. When sea level changes, the profile is no longer in equilibrium. If sea level falls, stream energy increases and starts to cut down actively and erode incised valleys; if it rises, the streams become more sluggish and deposit material in their lower reaches. On the Atlantic coast, since sea level is currently rising at a rate of about 25 cm a century,[1] streams and rivers are more liable to deposit than erode near the estuary. They are consequently less able to cut through and redistribute glacial material than they would if the base level were constant. Rising sea level thus reinforces the disorganizing effect on drainage patterns imposed by glacial deposition.

RELICS OF AN ANCIENT DRAINAGE SYSTEM

Some features in the fluvial landscape of Nova Scotia do not appear to be the product either of erosion since the Cretaceous or of glaciation. For example, the Musquodoboit River flows through a valley cut directly across the Granite Ridge (District 450). The Cobequid Hills are also crosscut by two valleys, the Folly Gap and the Parrsboro Gap, which were cut by rivers much larger than those that occupy them today (see Plate T3.2.1).

Several lines of evidence indicate that these are relics of a pre-Tertiary drainage system which developed at a higher level above the present erosion surface on a plain which was tilted towards New Brunswick. As the rivers cut down through the overlying strata, they became superimposed upon the rocks at the present level of erosion. The original direction of drainage (to the north) shifted 180°, and these rivers established a southerly flow, abandoning part of their old channels. Subsequent erosion and the disruption of glaciation has removed all but a few ghosts of these systems. This remaining evidence can be used to attempt a broad, speculative reconstruction of the ancient drainage network. For a fuller discussion, see Roland.[2]

WATERSHED BOUNDARIES

Watershed boundaries are continuously changing as rivers which drain areas of weaker rocks erode backwards and establish progressively larger drainage areas at the expense of neighbouring streams. For instance, in the interior of eastern mainland Nova Scotia many rivers which flow southwards to the Atlantic across the Atlantic Interior have lost part of their drainage areas to the West River St. Marys. Similarly, the watershed of Country Harbour River has been reduced by the westerly extension of the South River and Salmon River systems, which flow into St. Georges Bay and Chedabucto Bay respectively (District 570).

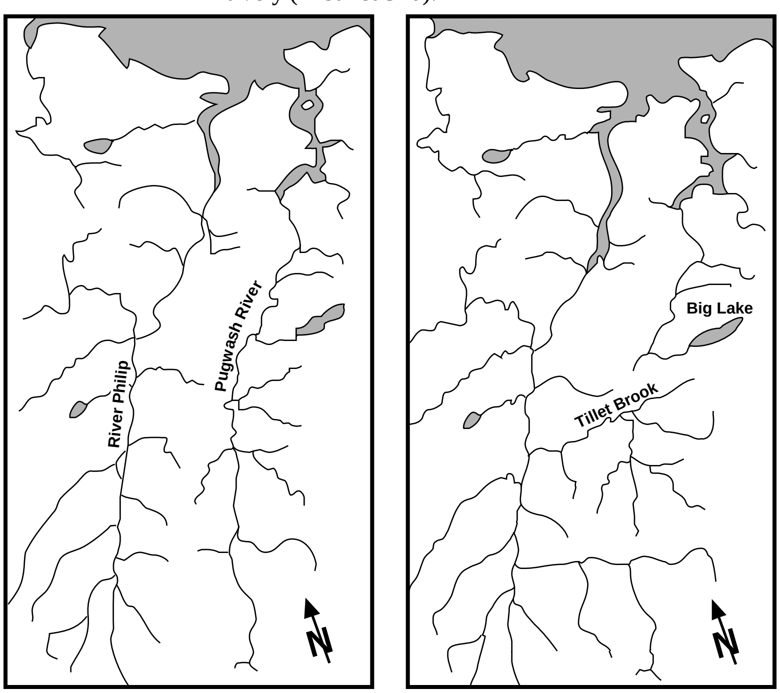

Figure T3.2.6: Example of river capture. River capture of former headwaters of the Pugwash River by River Philip. Both rivers exhibit a classic trellised pattern reflecting the east-west folds in the sandstone bedrock, District 520.

RIVER CAPTURE

There are numerous examples of river capture across the province, where streams or major rivers have been directed into the upper reaches of an adjacent watershed. A wind gap or dry valley is then left along the original course of the stream, and the remaining stream is undersized for the valley in which it flows.

An excellent example of river capture can be seen in the headwaters of River Philip, Cumberland County (see Figure T3.2.6). Several streams which once flowed down a fault into the Pugwash River have been diverted to the west and now flow into River Philip, parallel to their original course. Similarly, the Gaspereau River has intercepted the Black River at White Rock, Kings County, leaving an underfit stream to occupy the lower portion of the valley known as Deep Hollow.

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Associated Topics

T2.1–T2.7 Geology, T3.1 Development of the Ancient Landscape, T3.3 Glaciation, Deglaciation and Sea-level Changes, T3.4 Terrestrial Glacial Deposits and Landscape Features, T8.1 Freshwater Hydrology, T8.2 Freshwater Environments

Associated Habitats

H3.1–H3.6 Freshwater

References

1 Scott, D.B., R. Boyd and F.S. Medioli (1987) Relative Sea-level Changes in Atlantic Canada: Observed Level and Sedimentological Changes vs. Theoretical Models. *Society of Economic Paleontologists and Mineralogists Special Publication* No. 41.
2 Roland, A.E. (1982) *Geological Background and Physiography of Nova Scotia*. Nova Scotia Institute of Science, Halifax.

Additional Reading

• Bloom, A.C. (1969) *The Surface of the Earth*. Prentice-Hall, Englewood Cliffs, N.J.