Chapter One

THE INFLUENCE OF EARTH MOVEMENTS AND CLIMATIC CHANGE B.C.-1855

Extracts from *Rugged Landscape The Geology of Central New Zealand* by Graeme R Stevens, A H and A W Reed Ltd, 1974. Reprinted by DSIR Publishing, 1990.

To understand the present day river characteristics it is essential to appreciate that the river flows through a geologically new environment and is still responding to recent and major physical changes in the wake of earth movements, climatic change, and the exploitation of the Valley's natural resources.

If the exploitation of the forest and shingle resource had not taken place the river would now follow a course largely dictated by its geological and climatic history. The river would naturally flow within material deposited relatively recently, on a course determined by the extent and characteristics of earth movements, and by forest growth and the frequency of extreme events.

As a result of the arrival of the European immigrants and the immediate resource exploitation, the River now flows through ancient, deeper formations, controlled by man to an alignment based on the course it followed at the time of deforestation.

G R Stevens has provided a detailed account of the geological changes that led to the formation of New Zealand and, in particular, to the development of the Wellington basin in his publication *Rugged Landscape : The Geology of Central New Zealand*, A H and A W Reed Ltd, 1974; reprinted DSIR Publishing, 1990. The reader is also referred to Hutt River Flood Control Scheme Review 1990, Volume 2, *Climatology and Hydrology*, and Volume 5, *Paleohydrology*, I E Whitehouse, 1990, Land Resources Division, DSIR.

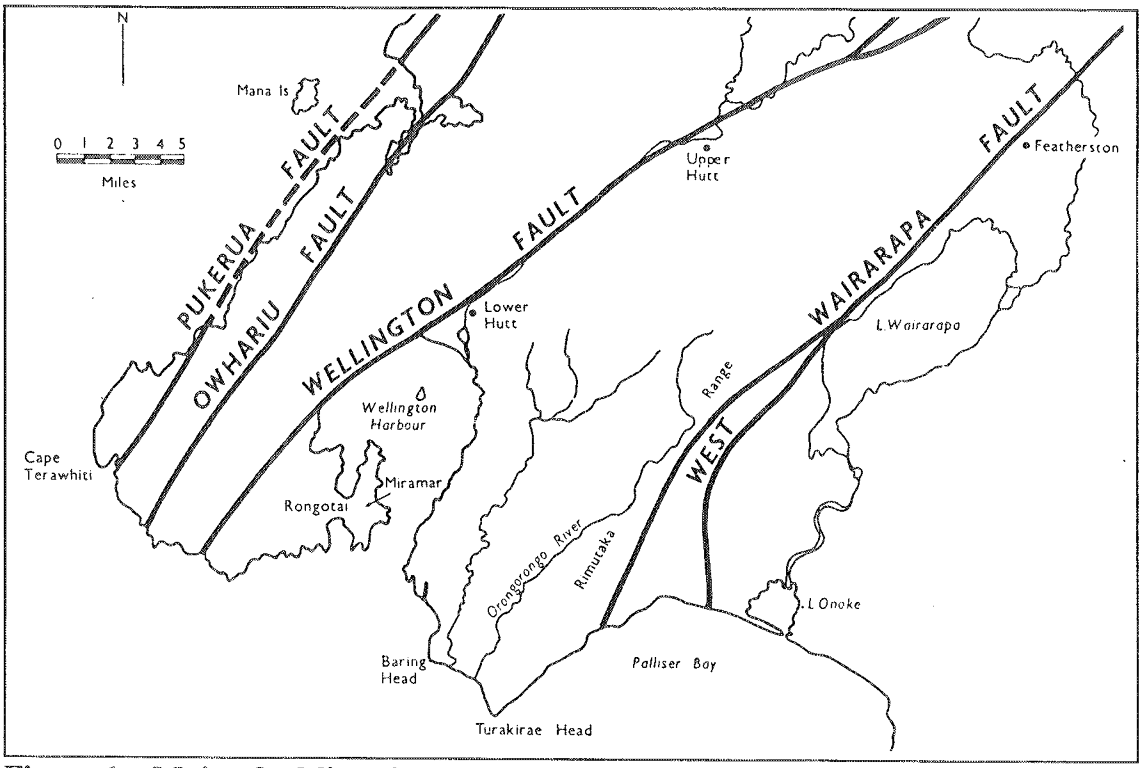


Figure 1: Major faultlines in the Wellington area.
Source: G R Stevens, *Rugged Landscape*, fig. 4.19.

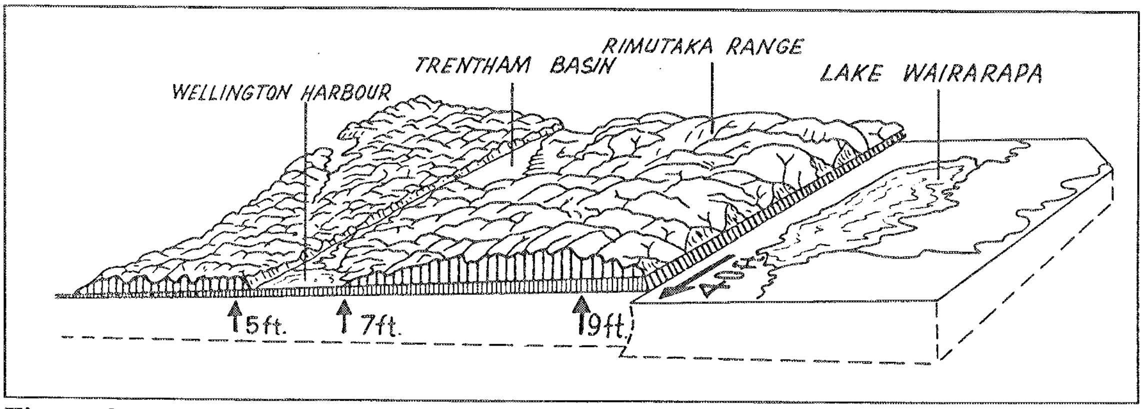


Figure 2: Fault movement, 1855 earthquake.
Source: G R Stevens, *Rugged Landscape*, fig. 13.2.

Geological Structure

The Hutt Valley floor is part of a large block, bounded to the east by the West Wairarapa Fault and to the west by the Ohariu Fault.

The block has been moving gradually upwards, tilting about the western (Ohariu) fault in a series of discrete movements. The "stepped" profile of headlands along Wellington's south coast chart the upward progress of the block and illustrate the massive displacements which have occurred in earlier times. Evidence of recent movements can be found on the raised beaches, seen clearly on the undisturbed foreshore at Turakirae Head (east of the Orongorongo River mouth), in the Petone area and beneath the roads following the Harbour perimeter. The last great movement occurred on the West Wairarapa Fault in 1855. This movement, of 2.7 m vertically and 12.2 m horizontally at the faultline, tilted the entire Wellington Region (see figure 2, p. 10) so that the Hutt Valley was raised by 1.5 m. This process of uplift is expected to continue indefinitely.

Movements along the Wellington Fault (figure 1, p. 10) have also contributed to the overall uplift of the Wellington Region. The most recent movement of the Wellington Fault occurred about 700-900 years ago and the breakage of the ground that took place at this time is visible as a scarp line running parallel to the Hutt Road (e.g., corner of Hutt Road and Wakefield Street, Petone) and traversing the terraces to the north of the northern arm of California Drive, Totara Park.

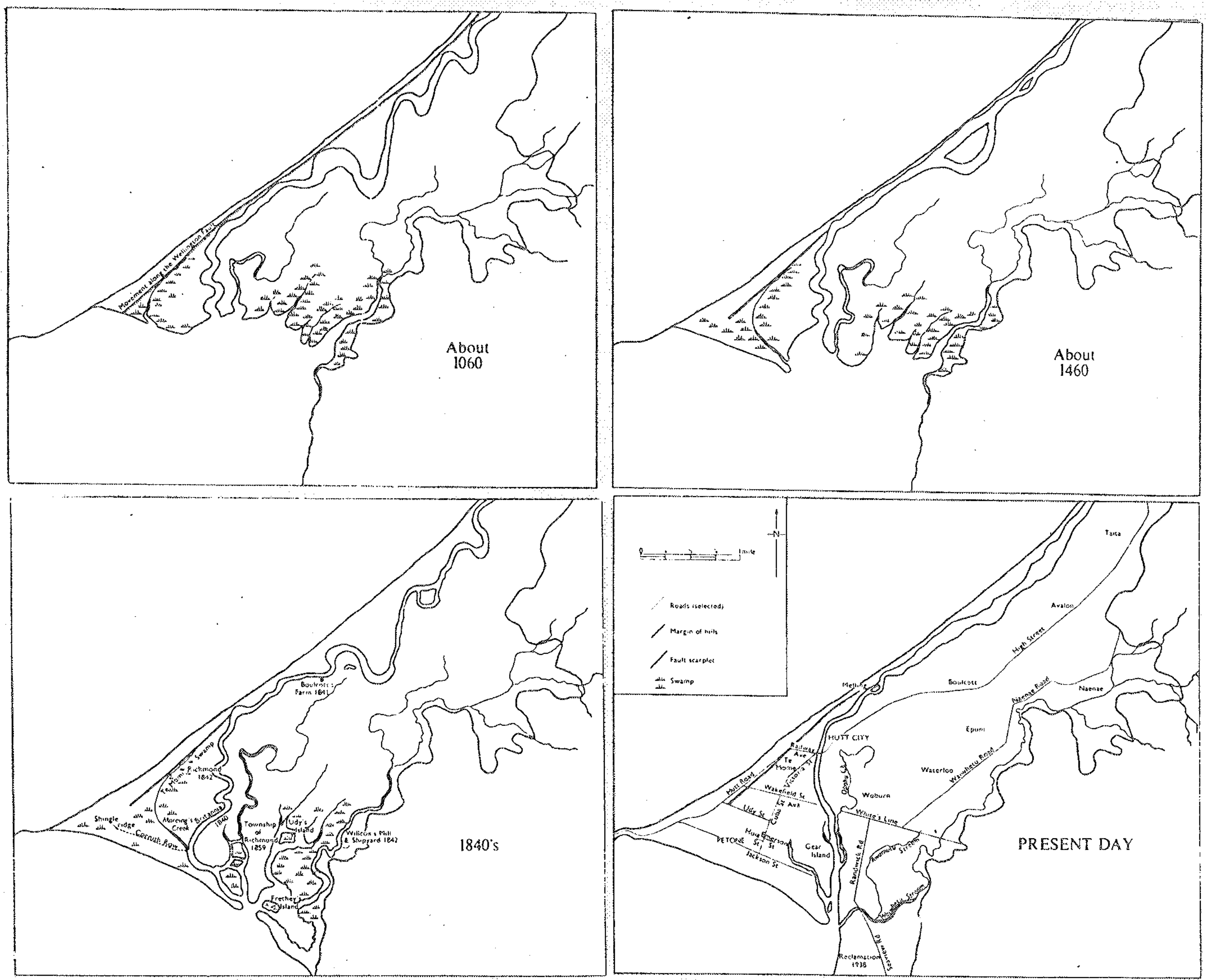
Not surprisingly, this fault activity has contributed towards determining the current river regime. Firstly, the tilting has tended to keep the river in its western course. Secondly, at each uplift the channel lengthens. The newly uplifted portion, previously the submerged river delta, becomes the river mouth. The regrading and reshaping of the old and new sections then takes place, accompanied by the creation of a new foreshore regime.

In addition to the uplift that accompanied the 1855 earthquake, recent uplifts have been dated circa A.D. 1460 (the "Hao-whenua" earthquake and formation of the Miramar Peninsula) and 300 B.C. (uplift of the Miramar flats). The changes in the Petone foreshore as a result of recent uplifts are shown in figure 3, p. 12.

Climatic Variations

Glaciation, in combination with the uplift process, led to the redirection of the watercourse from its ancient western course, through the Porirua Harbour, to its current southerly outfall (refer to figure 4, p. 14).

Before the formation of the Hutt Valley by downward movements along the Wellington Fault a number of rivers drained from the eastern mountain blocks (Rimutaka and Tararua Ranges) across the Western Hutt Hills (then extensive plainland) into the Porirua-Pauatahanui Basin (figure 4). However, all of this drainage became diverted towards the south (and into Wellington Harbour) in the



The diagrams show the evolution of the Lower Hutt Valley over the period AD 1000 to the present day. The 1060 movement on the Wellington fault produced a breakage of the ground surface as far south as Udy Street, where the shoreline was at that time. Between 1060 and 1460 material brought down by the Hutt River moved the delta front southwards to the position shown in 1460. At this time the Hao-whenua earthquake raised the harbour floor and left stranded the beach forming at that time to produce "The Rise" in Cuba Street. The foreshore had developed into swamp and tidal inlets by the 1840s when the Hutt River and Waiwhetu Stream were navigable for some distance and shipyards were established on their banks. The 1855 earthquake raised the Hutt Delta some 1.8-2.1 m, drained some of the swamps, reduced the depth of the rivers and extended the shoreline southwards. From G R Stevens, *Rugged Landscape*, p. 268-269.

Figure 3: Petone foreshore and Hutt River estuary in recent time.

Source: G.R. Stevens *Rugged Landscape*, figs 15.2 to 15.5

wake of formation of the Hutt Valley depression, beginning about 2 million years ago. During the Ice Age or Pleistocene Period, between 2 million years ago and 10,000 years ago (figure 5, p. 14), severe climates produced accelerated erosion on the valley side slopes and in the mountains.

Vast thicknesses of sedimentary materials were laid down in the Hutt Valley depression and remnants of the higher levels of these deposits are now seen as valley side terraces, particularly in the Upper Hutt Valley.

The coarse materials (rock debris, cobbles, gravel, etc.) that were laid down along the axes of both Lower and Upper Hutt Valley during the glacial phases of the Ice Age now form major layers of underground permeable zones, through which substantial flows of water pass in a down valley direction.

At the end of the Ice Age, 10,000 years ago, climate returned to that of the present day and sea level rose to its modern position. The Hutt Delta, that the Hutt River had built out into the head of Wellington Harbour during the Ice Age, became densely vegetated with lowland podocarp forest and swamp plants.

Between 5,000-4,000 years ago the earth's climate became warmer and wetter than that of today and in response to this climatic change sea level rose to 2 m above its modern position. During this warm phase (the Post-glacial Climatic Optimum) sea flooded in across the seaward edge of the Hutt Delta, overwhelming the existing forest and depositing a thick layer of silt, clay and peat that now forms the impermeable capping bed of the Hutt artesian system.

The ancient forest that lived on the Hutt Delta before the Climatic Optimum has been preserved as fossilised logs and stumps. Before the construction of the Melling Cut fossil forest materials were visible in the base of the river bank upstream from Melling Bridge (see plate 2, p. 15).

The Hutt artesian system has provided a reliable and high quality water supply that assisted in the industrial development of Petone. The artesian system is graphically illustrated in figure 6 (p. 16), and plate 3 (p. 15) shows one of the first commercial exploitations of the aquifer. Plates 4, 5 and 6 (pp. 17, 18, and 18) illustrate the dense lowland forest which covered the valley floor at the time of European settlement.

The current river regime is the subject of two separate Scheme Review Volumes: **Volume 5, *Sedimentation and River Characteristics***, and **Volume 6, *River Channel management and Protection Works*. Volume 2, *Climatology and Hydrology***, includes a study of the Hutt River paleohydrology, and consideration of past and future climatic variations.

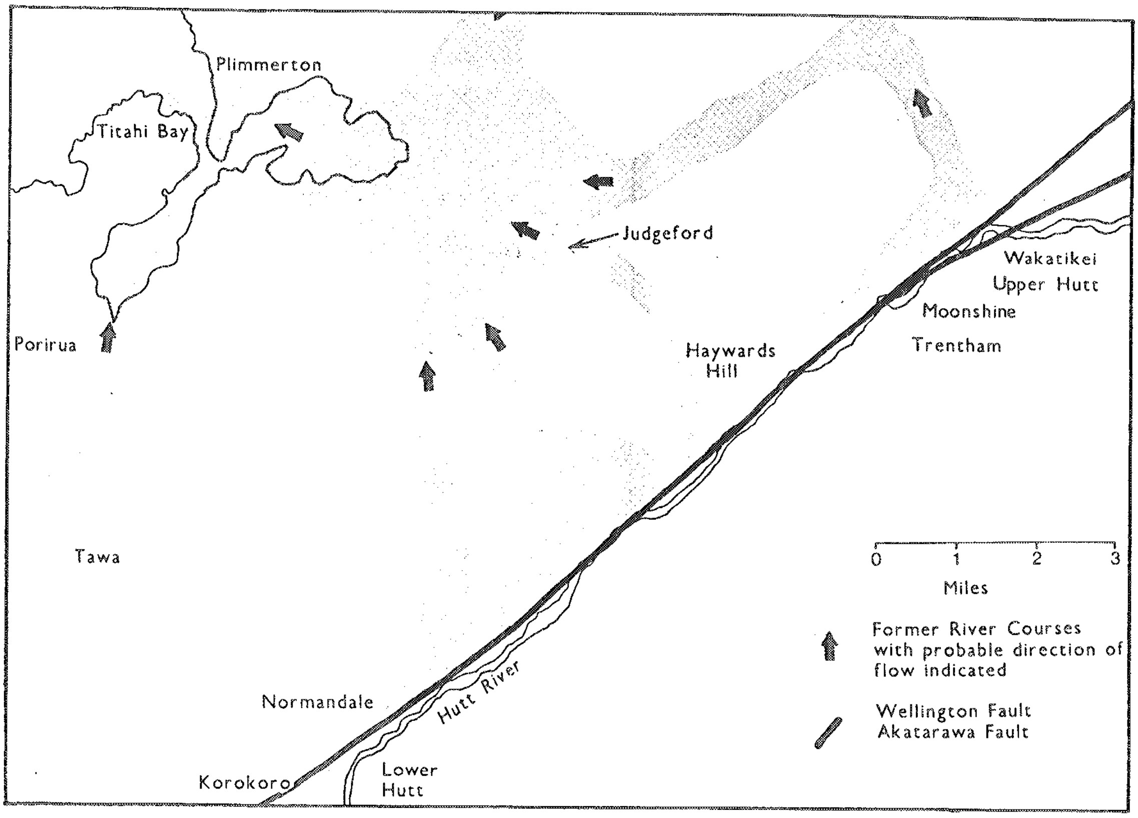


Figure 4: River courses across the Western Hills.
Source: G R Stevens, *Rugged Landscape*, fig. 3.6.

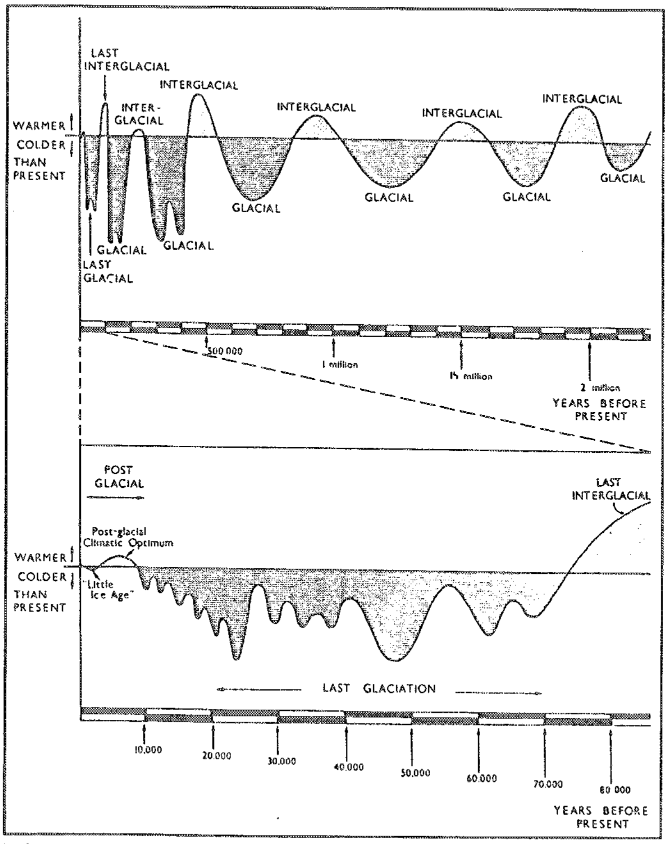


Figure 5: Climatic Changes.
Source: G R Stevens, *Rugged Landscape*, fig. 8.1.

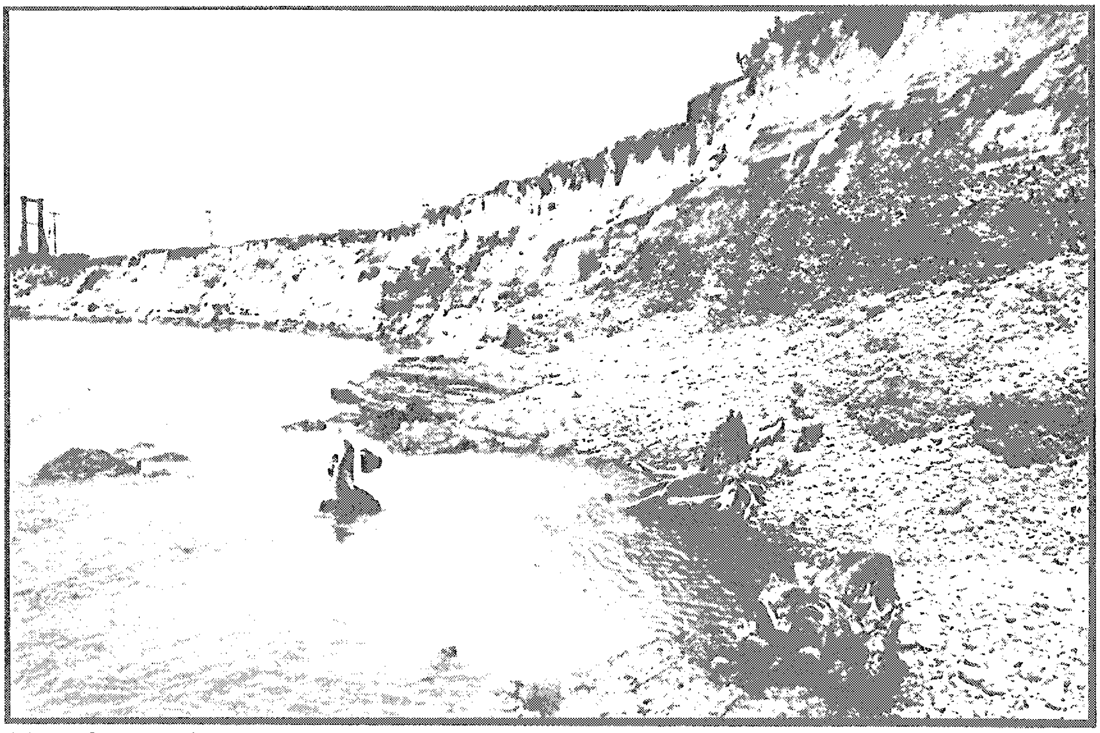


Plate 2: Ancient forest remnants.
Source: G R Stevens, "Rugged Landscape", fig. 10.4, p. 208.

Plate 2 shows the fossilised logs and stumps exposed at the base of the Melling Terrace. Age: 4,300-4,500 years ago. Photograph taken in 1954. The artesian bores shown in Plate 3 are probably located at the eastern end of Jackson Street, Petone.

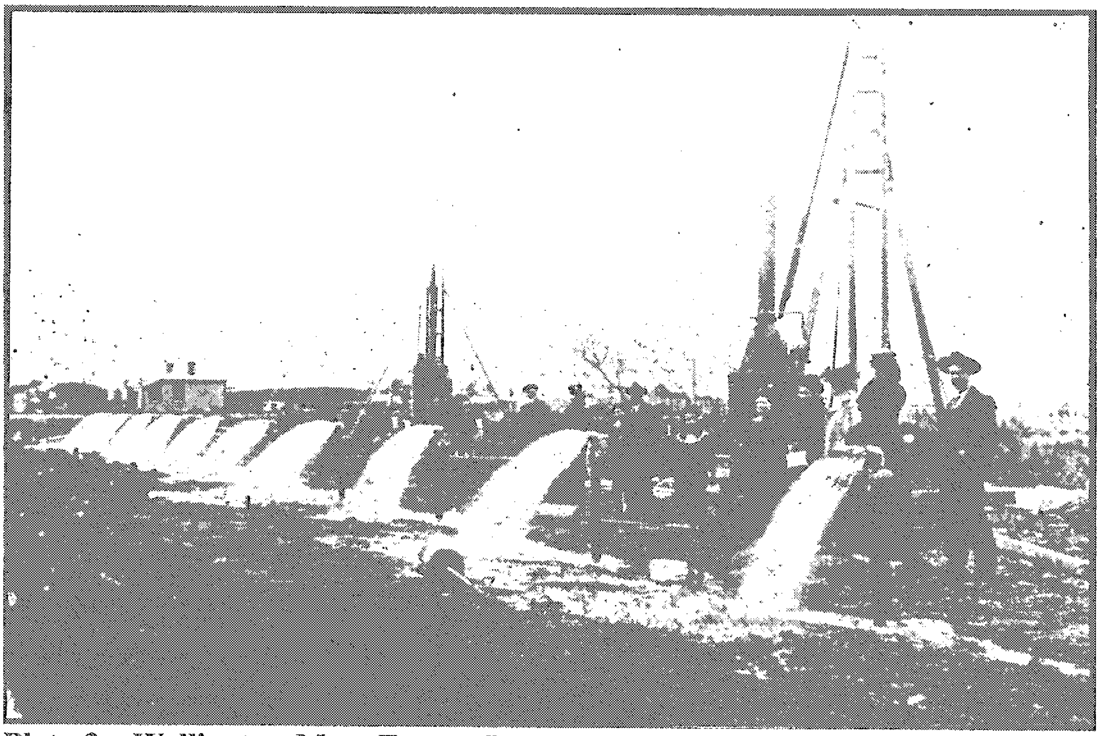


Plate 3: Wellington Meat Export Bores
Source: National Museum neg. B11444

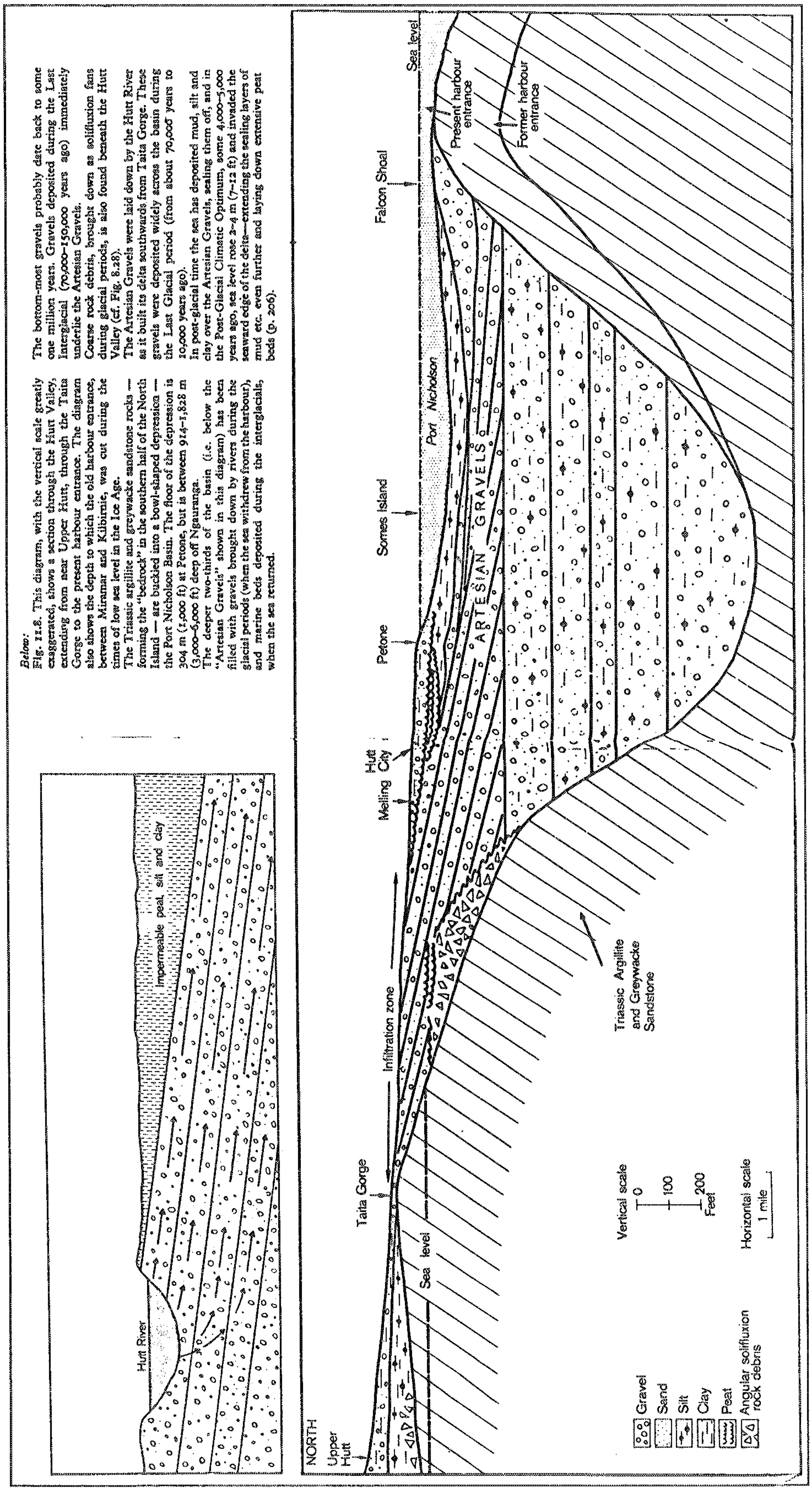


Figure 6: Hutt Valley Artesian System.

Source: G R Stevens, *Rugged Landscape*, fig. 11.8

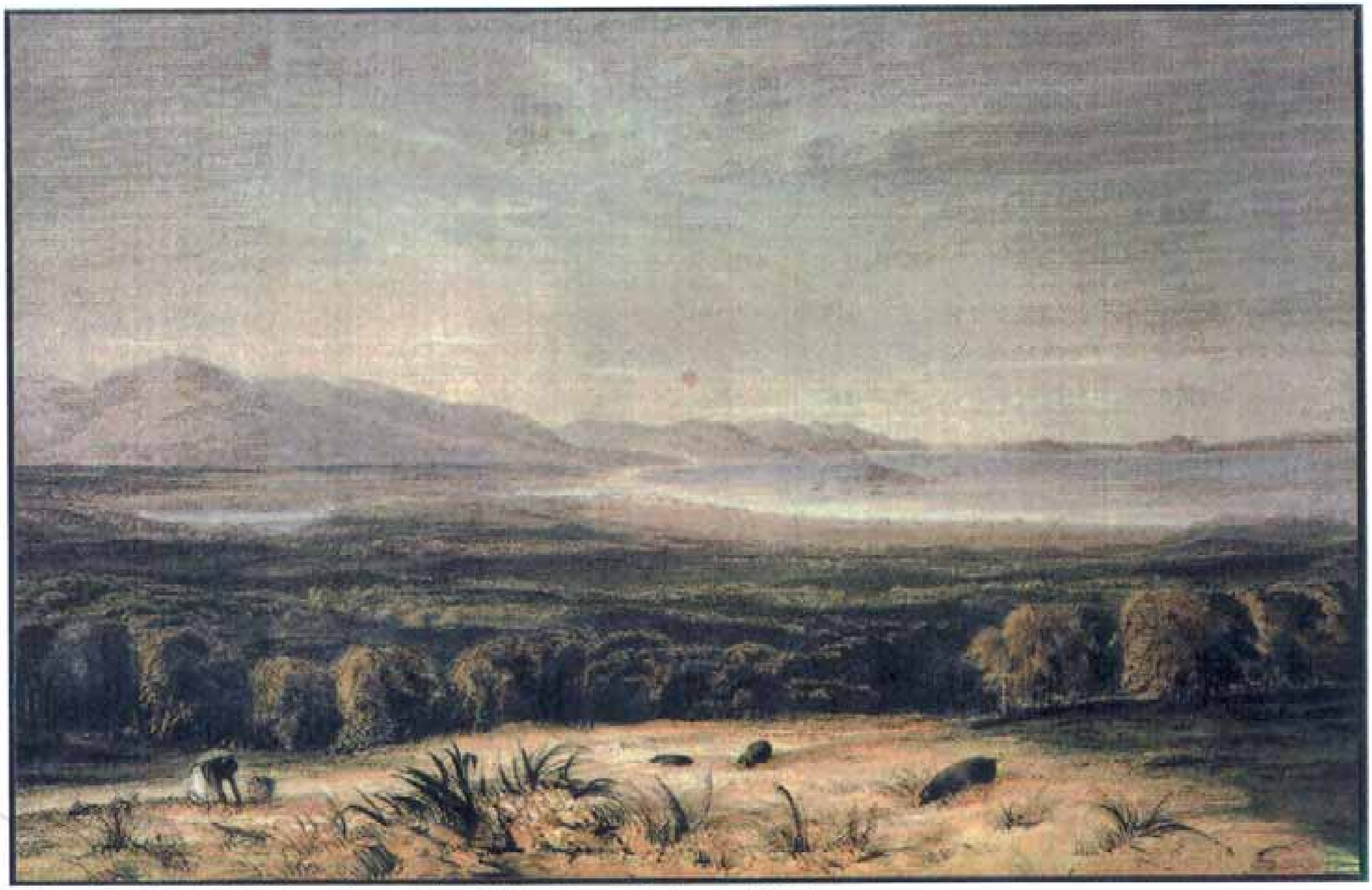


Plate 4: Port Nicholson from the Hills above Petone, 1847.
Source: Alexander Turnbull Library, Charles Heaphy, ref. Art Room F919 31

Left: Figure 6 is a diagrammatic representation of the lower Hutt Valley and Wellington Harbour to illustrate how seepage from the bed of the Hutt River percolates downwards to become trapped under impermeable layers to produce the Hutt Valley artesian systems.

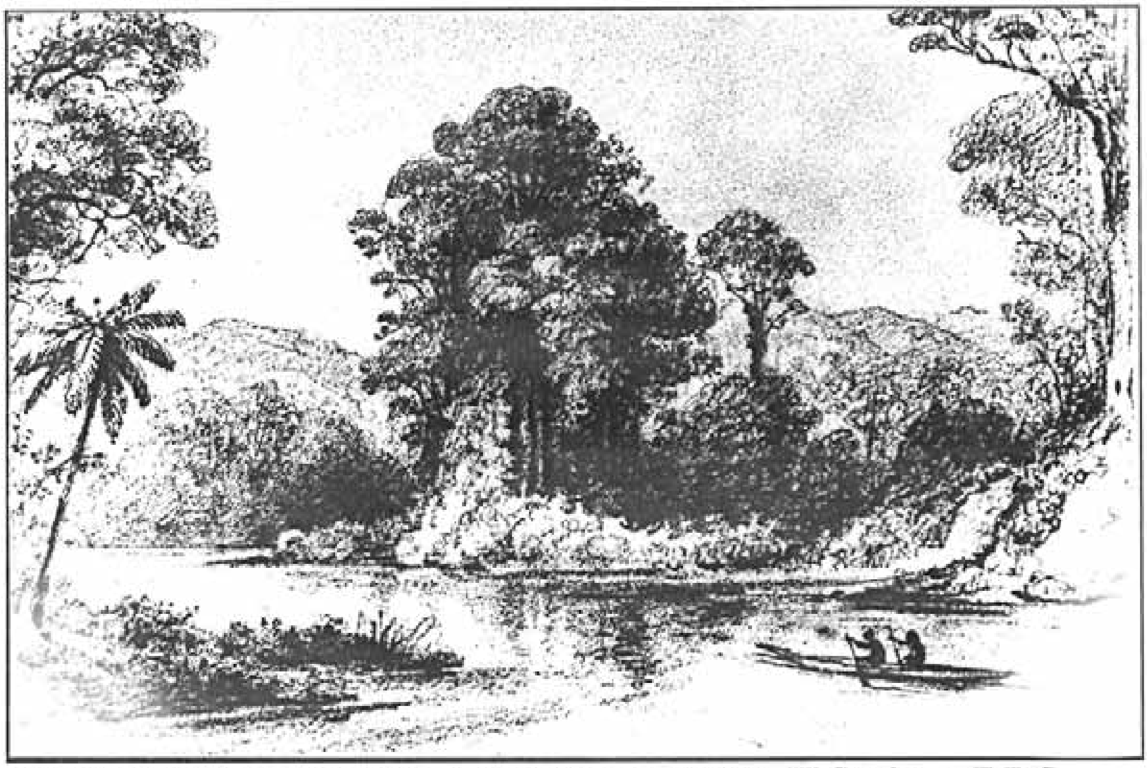


Plate 5: Hutt River near the mouth 1843, sketched by W Swainson F.R.S.
Source: Wellington Maritime Museum neg.

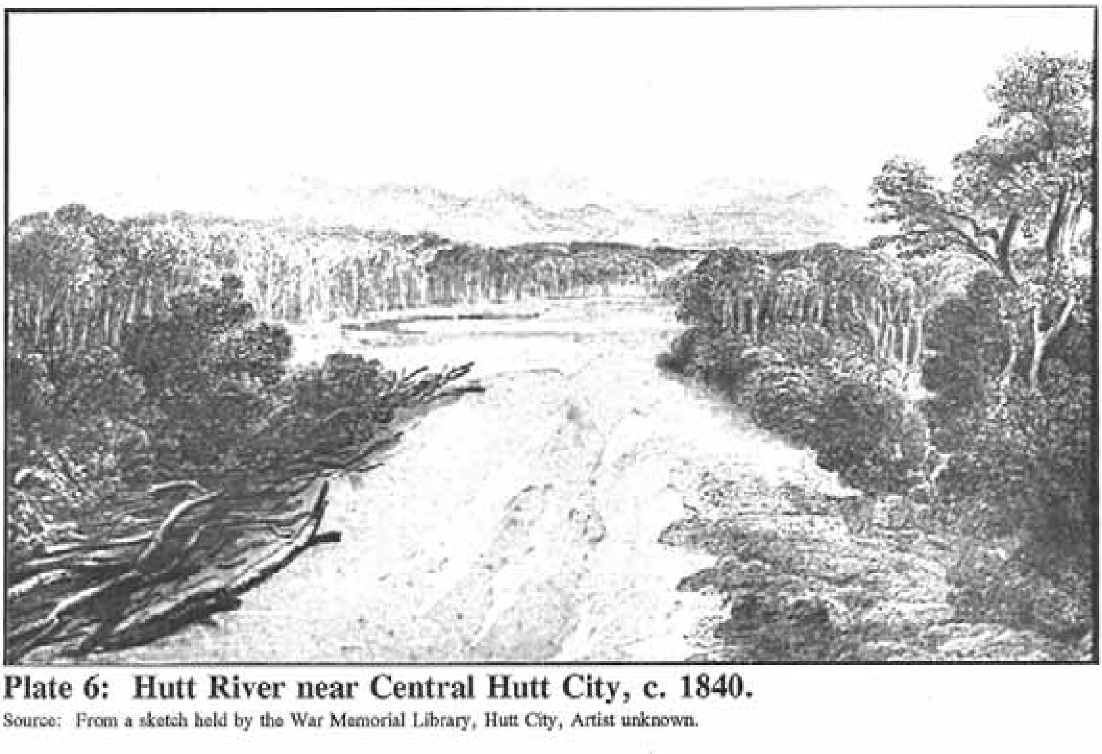


Plate 6: Hutt River near Central Hutt City, c. 1840.
Source: From a sketch held by the War Memorial Library, Hutt City, Artist unknown.