

THE GEOLOGY OF THE QUEEN STREET AREA, AUCKLAND, NEW ZEALAND

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SUMMARY

The geology along Queen St Auckland, consists of underlying Miocene marine deposited flysch and associated soils. This material is overlain by Quaternary volcanics, alluvium and recent fill, all of variable geotechnical character. Of geological importance is a lava flow which flowed down the paleovalley underlying present day Queen St, from the corner of Victoria St east. The original paleovalley gives clues as to the extent of this flow however more information is required to determine its terminal extent north and lateral extent east. The course of the Ligar stream last century is useful to determine the extent of reclamation.

INTRODUCTION

The Queen St area of the Auckland central Business district is economically important to the wider Auckland region. The geology that underlies Queen St is in places complex. To be able to interpret the information found from limited site investigations it is important to have an understanding of the wider geology that is present.

This paper presents a summary of the geology along Queen St, highlighting areas where information is sketchy, and where further research is required to build a definitive picture of the geology.

GEOLOGICAL SETTING

The geology of the area around Queen Street Auckland, consists of an underlying "bedrock" of Miocene-aged marine deposited sandstones and mudstones of the Waitemata Group, with an overlying layer of associated weathered soils. Much of the original geomorphology has been modified and is currently covered with buildings. What can be deduced from available information is that before Quaternary volcanism, the area corresponding to what is now the central business district (CBD) featured moderately elevated hills comprised of Waitemata Group rock and residual soils. Slopes were steep and the terrain was dissected by numerous small streams in deep valleys, including what was to become known as the Ligar Stream. The Ligar Stream flowed north down the "Queen St gully", a paleovalley that runs beneath the corner of Queen and Wellesley St's at RL -1m (Datum M.S.L today) and passes beneath Customs St between Fort Lane and Queen St at approximately RL-10m, and crosses below Queens Wharf in a northwesterly direction at RL-14m, to eventually join the ancestral Waitemata River bed[1] at RL -30m beneath the Waitemata Harbour (Figure 1).

Approximately 60 000 yrs. ago the Albert park volcanic centre erupted explosively onto higher ridges east and south of the centre, depositing ash, lapilli, and ash/lapilli tuff. Later a small lava flow from this centre flowed down Victoria St East passing northwest under the corner of the AMP building. The flow then travelled northwards down the Queen St gully. The western edge of the flow has been traced passing under buildings along the western side of Queen St as far as the southern corner of Queen and Wyndham St's[2] where the flow passes back to the northeast under the western edge of Queen St following the old "Queen St gully" towards what is now the Fort Lane end of Fort St.

The flow itself although relatively short, is thick (10-12m at the corner of Durham and Queen St's), and effectively dammed the Queen St gully. Behind the lava dam, reworked ash/lapilli and tuff materials were deposited with other alluvial sediments and vegetation washed in from the hill slopes behind, building an alluvial flat that extended upstream as far as Myers St today. Subsequently the Ligar Stream continued to flow along the western edge of the lava flow, issuing from the coastline at the corner of Fort and Queen St's onto marine mud flats.

Last century extensive reclamation of bays along the foreshore of Auckland resulted in fill material being emplaced from Fort St (formerly Foreshore St) out to Quay St. This fill derived for the most part of reworked local Waitemata Group materials (soil and rock) directly overlies insitu marine sediments as far as Custom St East. Below QEII Square a combination of marine mud and hydraulic fill was emplaced upon Waitemata Group Rock and capped with the same Waitemata Group derived fill material as found further up Queen St.

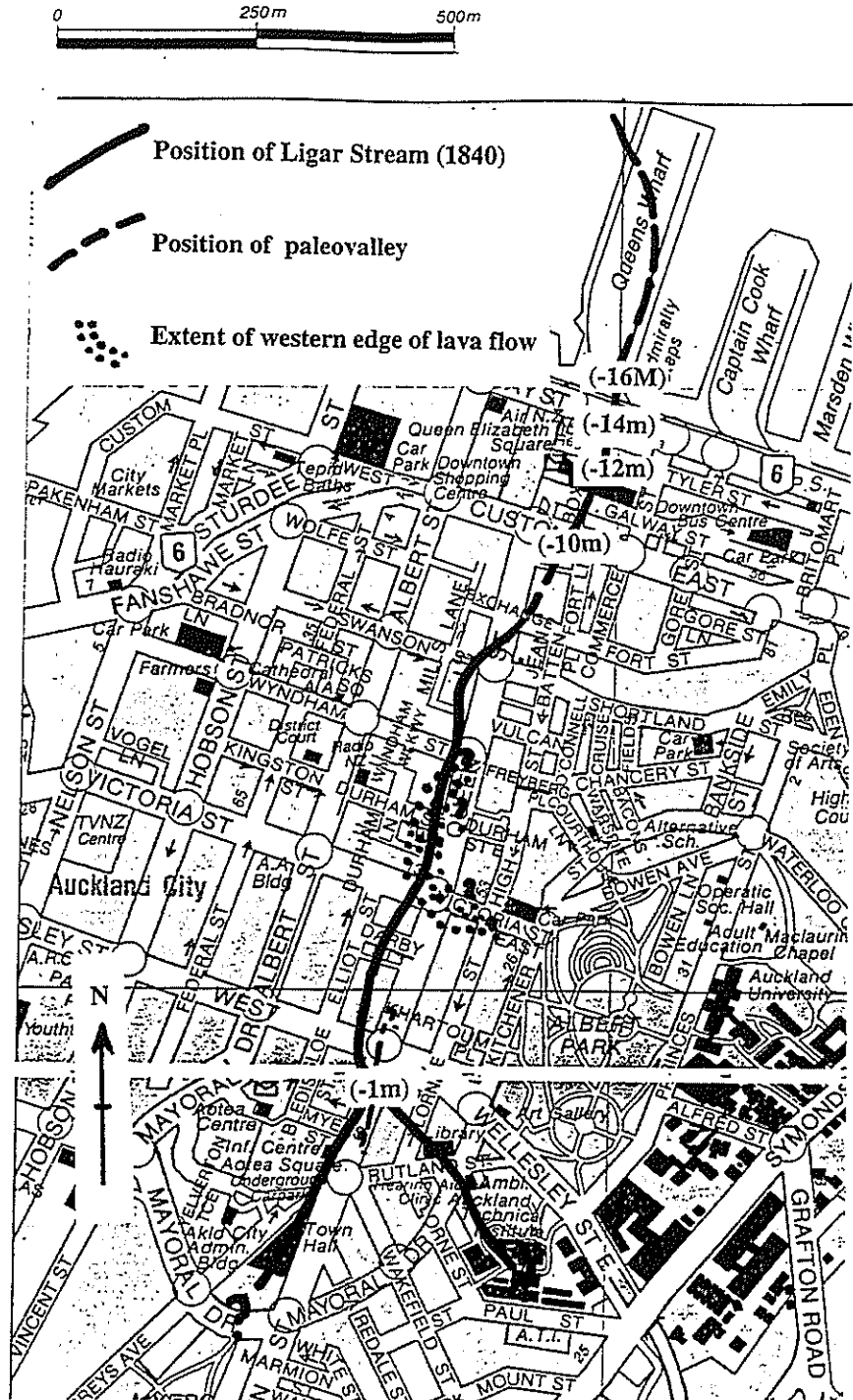


Figure 1: Sketch plan showing the bottom of the “Queen St gully” paleovalley (dashed line) in relation to present day streets with approximate RL depths in brackets (datum is the mean sea level today). The solid line represents the position of the Ligar Stream last century which was displaced from the paleovalley by the lava flow approx. 60 000 yrs BP (shown in dots), and which flowed onto marine sediments at the corner of present day Queen and Fort St’s.

GEOLOGY ALONG QUEEN STREET

A geological long-section has been plotted along a section-line drawn from the old postoffice on QEII square, up Queen street to approximately 200m southwest of Mayoral Drive (Figure 2).

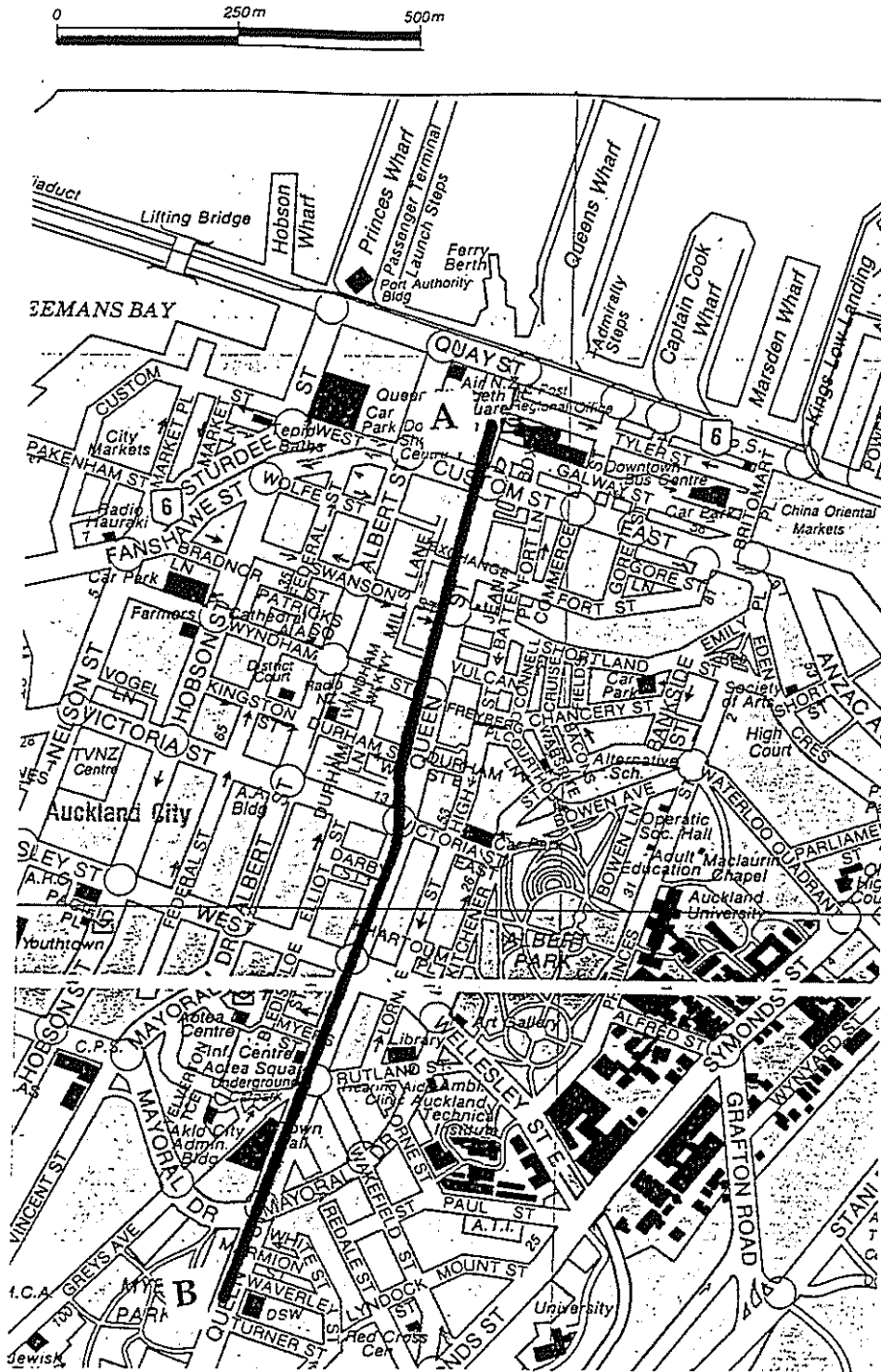


Figure 2: A plan showing the section-line, represented by the solid line, from which is drawn the the longsection. It is plotted from the old postoffice on QEII square up Queen St to approximately 200m southwest of Mayoral Drive.(see figure 3).

Geological information plotted on the long-section and the summary of the nature of the material, is based on a general knowledge of these materials, and drillhole information from the data files of WORKS Consultancy Services Ltd (WCS) and the Auckland City Council (ACC). Ground conditions at each position are inferred and extrapolated from this existing data drawn from specific projects at isolated localities along Queen St. Of note is the likely lateral variation of ground conditions across Queen Street which cannot be assessed from this study. Specific investigation is required to verify any extrapolation, especially any lateral variation.

0-100m: We encounter 3-8m of very soft-firm clay and medium dense sand (hydraulic fill), overlaid by 3-4m of very soft to firm clayey/sandy SILT. Below the hydraulic fill is 3m of soft-firm sandy clay, silt, and clay (marine sediments), overlying 1-3m of firm-stiff clayey sand, silt and clay (HW-CW Waitemata Group) and Waitemata Group rock.

100-250m: We find soft-firm clayey sand, silt and clay (marine sediment), overlying 0.2-3m of firm-stiff clayey sand, silt and clay (HW-CW Waitemata Group). At 250m Marine sediments directly overlie very weak-weak interbedded mudstone and sandstone (Waitemata Group Rock) before pinching out against weathered Waitemata Group soils.

250-425m: We find stiff-hard clayey sands, silts, and clay (SW-HW Waitemata Group rock) 0-8m thick. Underlying this is Waitemata Group rock.

425-625m: We pass through weathered basalt consisting of loose-medium dense scoria/basalt fine-coarse gravel. Below this from 0-3m is moderately strong/strong highly fractured basalt, to approximately 19m below the surface at 485-490m metrage(RL -10m). The basalt overlies Waitemata Group rock.

625-700m: We have 1-2m of stiff sandy, clayey SILT (alluvium and reworked tuff) overlying stiff sandy SILT, clay, fine scoria, basalt gravels, and peat (alluvium and reworked volcanics). This material sits above firm-stiff clayey sands, silts, clays of HW-CW Waitemata Group soil which in turn overlie Waitemata Group rock 3-5m underneath.

700-975m: We encounter 3m of firm-stiff silts and clays (ash/tuff), overlying alluvium consisting of firm-stiff sandy silt, clayey sand, clay, reworked basaltic gravels and rare thin layers of organic clay and peat. From 850-975m the alluvium directly overlies Waitemata Group rock.

975-1275m: We find firm silts and clays (weathered ash/ash tuff) becoming shallower in depth (6-1m) approaching Mayoral Dr. This sits on top of approximately 7m of firm-stiff clayey sands, silts and clays (HW-CW Waitemata Group). While below this lies Waitemata Group rock.

AREAS REQUIRING FURTHER RESEARCH

No information was made available to enable determination of the eastern boundary of the lava flow or to determine the position at which the lava flow terminates. More information on the boundaries of the paleo-valley down which the lava flowed may give an estimate of the dimensions of the flow in addition to borehole information along the eastern side of Queen St and other streets immediately to the east. Of further interest may be the influence the lava flow has on the local hydrogeology, as no information of this nature was available.

CONCLUSION

The geology of the Auckland central business district is complex. It includes a wide variation of both rocks and soils. Rocks range from soft weak sandstone s and siltstones to moderately strong basalt. Soils are soft-very stiff sands, silts and clays. Understanding the spatial relationship of each material to the other is tied in with an understanding of the local geology at each individual site. An understanding of the overall geology will provide an important framework in which to plan an appropriate site investigation.

ACKNOWLEDGEMENTS

WORKS Consultancy Services Ltd were commissioned to undertake a desktop study summarising the geology of the Auckland central business district in view of a proposed light rail network servicing this area. Information was gathered from WORKS Consultancy Services files and Auckland City Council records. Of this latter resource it is acknowledged the contribution of other engineering consultancy companies over the years.

REFERENCES

- 1 Searle, E J 1964. *City of Volcanoes - A Geology of Auckland*. Paul's Book Arcade.
- 2 Taylor, PW, Callander, RA, Entrician, GC, Tonkin, RM, Beca, GS and Taylor, PW 1967. *Building Foundations in Auckland City*. Fifth Australia - New Zealand Conference On Soil Mechanics and Foundation Engineering.