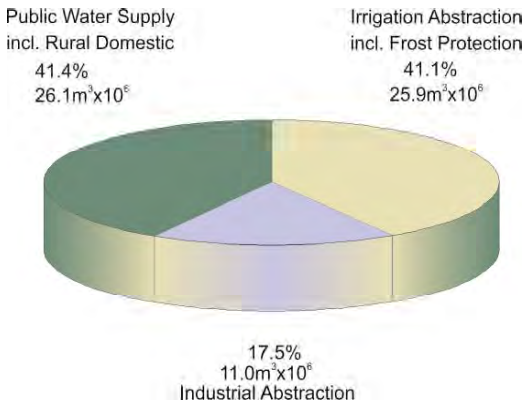
Heretaunga Plains GROUNDWATER STUDY

INTRODUCTION

The Heretaunga Plains comprise an area of 300 km^2 on the east coast of the North Island of New Zealand (Fig. 1), incorporating the urban areas of Hastings, Havelock North and Napier. The Plains were formed during the last 250 000 years by river sediments deposited by the Tutaekuri, Ngaruroro and Tukituki rivers and coastal lagoon, estuarine and embayment deposits. The Heretaunga Plains are underlain by sequences of fluvial gravel, sand and silt, interbedded with marine gravel, sand and silt channels. There is a general layered structure with coarse permeable gravel beds alternating with fine impermeable beds. The permeable gravel beds form aquifers which in plan reflect their formation as meandering river channels.

The groundwater underlying the Heretaunga Plains is a major natural resource which provides about 85% of the Heretaunga Plains and adjacent areas water requirements. Approximately 63 million cubic metres of groundwater was withdrawn during the year July 1994-June 1995 period for public water supply, irrigation and industrial uses. Figure 2 indicates the water used in three principal sectors.



Heretaunga Plains groundwater use during July 1994-June 95

Demand for irrigation from groundwater has expanded considerably in the last twenty years. The combination of temperate climate, fertile soil and groundwater for irrigation, enables the production of about 50% of the total New Zealand harvest of fruit, vegetables and grapes on the Heretaunga Plains. During dry periods, agricultural and horticultural production is heavily reliant on irrigation from groundwater supplies. Currently there are 2500 resource consents for groundwater abstraction on the Heretaunga Plains, of which 2420 are for irrigation.

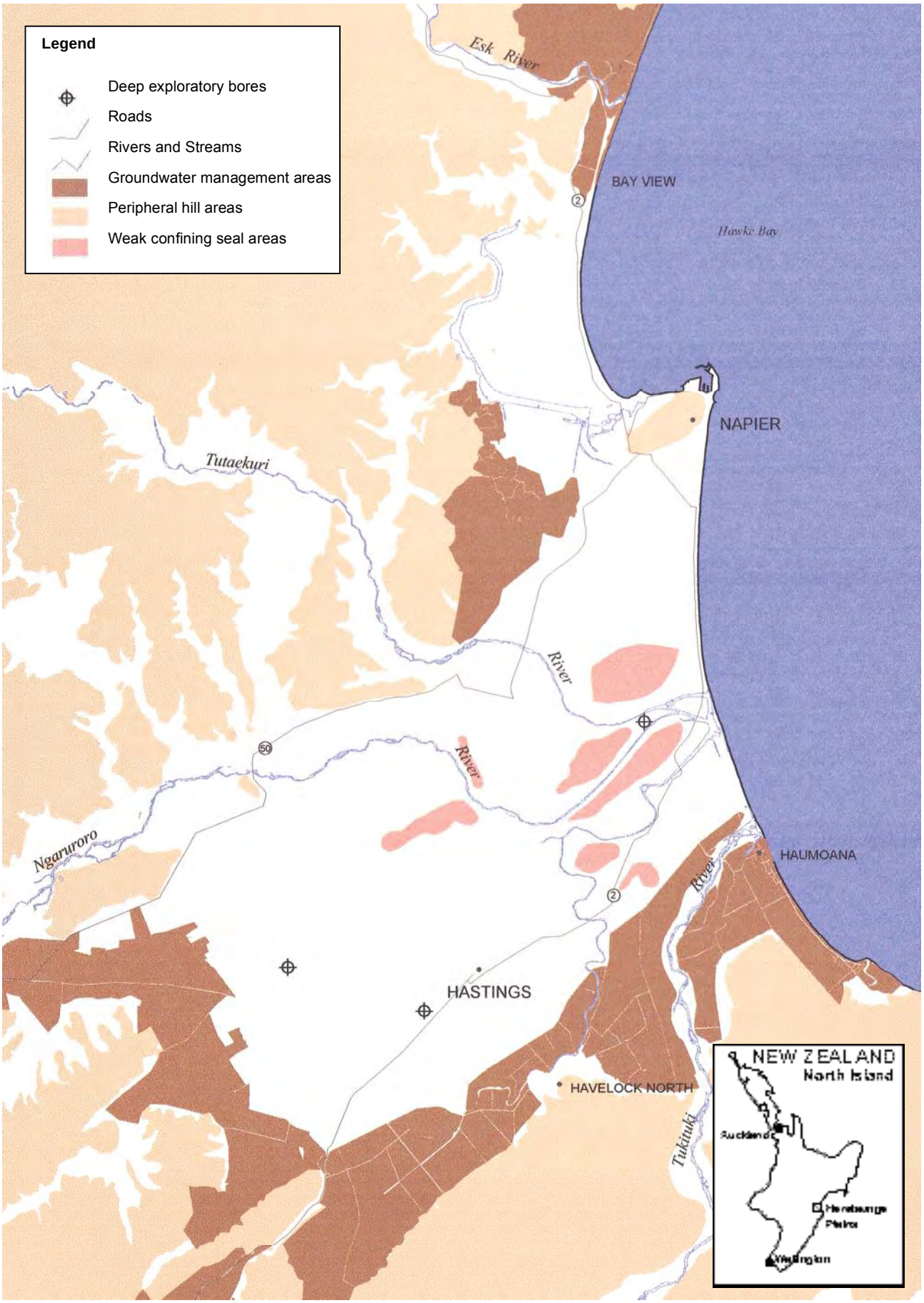
Since the discovery of artesian groundwater in the Heretaunga Plains in 1867 numerous groundwater investigations have been undertaken to determine how the aquifers were formed, the sources and flow of water in the aquifers and, in particular, susceptibility to contamination. While these investigations extended groundwater knowledge considerably, it was not until 1991 that a co-ordinated and systematic regional investigation began. The impetus for this renewed research and investigation was provided by a significant, new legislation. The Water and Soil Conservation Act (1967) was replaced by the Resource Management Act (RMA) in 1991. The new legislation required a far wider perspective of environmental management, with a specific focus on the *effects* of activities.

STATUTORY CONTEXT

The RMA has as a core requirement, the promotion of sustainable management of physical and natural resources. The RMA places specific emphasis on:

- sustaining the potential of natural and physical resources;
- safeguarding the life-supporting capacity of air, soil, water and ecosystems;
- avoiding, remedying or mitigating any adverse effects of activities on the environment.

The Hawke's Bay Regional Council (HBRC) has identified objectives and priorities for achieving sustainable resource management in the Hawke's Bay Region in the Regional Policy Statement (RPS), which provides direction for a comprehensive Regional Water Resources Plan (RWRP). The Heretaunga Plains groundwater study will provide additional technical input to future reviews of the RWRP.



Locality map of the Heretaunga Plains.

INVESTIGATIONS AND RESULTS

Review and collate the existing groundwater information and identify the gaps in knowledge.

Significant "gaps in knowledge" identified were:

- the geological history of deposition and the depth of the aquifer sequence beneath the Heretaunga Plains;
- the groundwater flow direction and flow rates;
- the spatial and time aspects of groundwater chemistry and influence of landuse activities and aquifer lithologies;
- total groundwater recharge, abstractions and outflow;
- the vulnerability to pollution and the continuity of groundwater availability of the aquifers at the fringe of the Heretaunga Plains aquifer system.

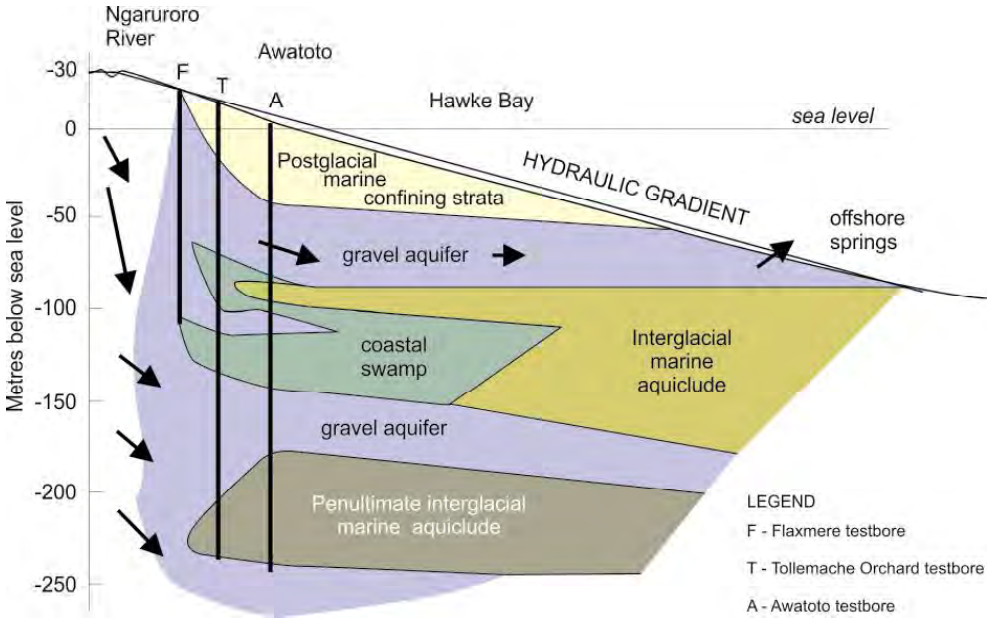
GEOLOGICAL HISTORY OF DEPOSITION AND THE DEPTH OF THE AQUIFER SYSTEM.

Three deep exploratory bores were drilled to provide information on the geological history and the depth of the aquifer sequence beneath the Heretaunga Plains.

The drilling, and strata and groundwater sampling and analyses, established that a 250,000 years glacial / interglacial strata sequence was present to a depth of 250 m with interbedded and interconnected gravel aquifers. Deposition had occurred in a depression subsiding at a rate of 1 m per 1000 years.

Figure 4 illustrates a generalised cross section through the three deep exploratory bores and offshore Hawke Bay. The Flaxmere testbore located in the unconfined aquifer area encountered water bearing (saturated) gravels to the final depth of 137 m. The Tollemache Orchard bore located in about the middle of the Heretaunga depression was explored to a final depth of 256 m. Five flowing artesian and one subartesian aquifers were encountered. The coastal Awatoto testbore penetrated six flowing artesian aquifers. The piezometric pressures in Tollemache Orchard testbore show gradual decrease with depth whereas the piezometric pressures increase with depth at the Awatoto testbore. Because of the shallow depositional gradient of the aquifers, only the upper gravel aquifers are likely to outcrop on the sea floor and discharge fresh water into the ocean in Hawke Bay.

The decreasing piezometric pressures observed at the Tollemache Orchard testbore and other deeper bores in the inland Plains, support the concept of a hydraulically interconnected system with a common groundwater recharge source area. Increasing piezometric pressures with depth in the aquifers near the coast suggest a closed or partly closed deeper aquifer system with flow in deeper aquifers maintained by upward leakage through aquitards and aquicludes.

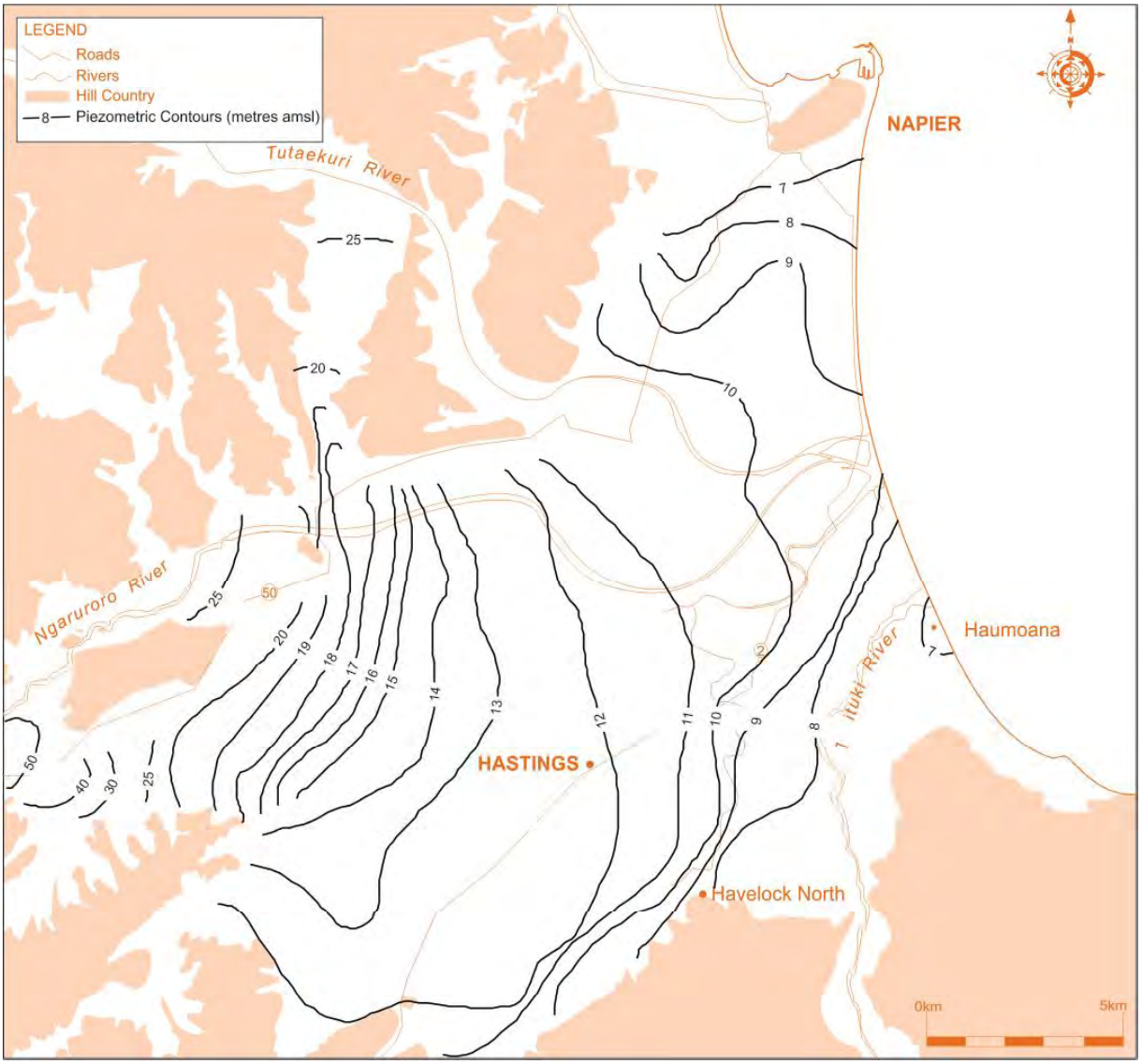


Generalised cross section showing exploratory bores and off-shore Hawke's Bay.

Isotope and chemical analyses of groundwater to 250 m depth suggests a Ngaruroro River recharge.

GROUNDWATER FLOW DIRECTION AND FLOW RATES

A piezometric survey of water levels in 450 wells on and adjacent to the Heretaunga Plains was undertaken on the weekend of 18-19 February 1995. At the time Hawke's Bay was experiencing a drought so the survey provided an excellent opportunity to observe the response of the aquifers to dry conditions. The piezometric contours, gradual decrease in the aquifer pressures with depth, isotope and chemical analyses and river gauging data suggests recharge from the Ngaruroro River between Maraekakaho and Roys Hill. Low flow river gaugings confirm a loss of about 432,000 m^3/day in this reach (Fig. 1). The river water enters the unconfined aquifer through southeasterly trending former river channels that cross and underlie the Plains between the current river course and Flaxmere. The piezometric contours (Fig. 5) show the Ngaruroro River as the major source with groundwater flow eastwards towards Flaxmere and Hastings, then northeastwards toward Taradale and Napier. Isotopic (tritium and oxygen 18) and chemical analyses of groundwater from 32 wells confirm the Ngaruroro River as the recharge source and show that the rate of groundwater flow



Heretaunga Plains piezometric contour map (18-19 February 1995).