

Appendix D:

Case Study D – Doyleston Drain, Environment Canterbury

In 1998 Environment Canterbury supported a ME research project (Weir, 1999) which involved a detailed pumping test adjacent to a springfed drain. The Doyleston Drain was excavated to drain farmland around Lake Ellesmere and is a linear feature with a 2.5 m wide gravel bed and near vertical grassy banks (Figure D1).

Driller's logs from the area indicate the presence of a surface low permeability silt/clay layer around 1.7 m thick overlying a sandy gravel layer to a depth of 2.8 m which, in turn, overlies a permeable gravel aquifer approximately 20 m thick. A pumping well (200 mm diameter, screened from 8.15 – 10.15 m deep) was installed 55 m from the drain, as shown in the cross-section in Figure D2.

To test for stream depletion effects a network of observation wells was established around a pumped well and a stream, as shown in Figure D3.

The well was pumped at a rate 17.5 L/s for 10 hours whilst water levels were measured in the pumped well and in nearby observation wells. In addition, stream flow was measured at weirs located 200 m upstream and 200 m downstream of the pumped well position.

The resulting drawdown from two observation wells located 25 m either side of the pumped well is plotted in Figure D4 and indicates the recharging effect of stream seepage (borehole 4 is located between the pumped well and the stream whereas borehole 2 is located on the opposite side of the pumped well). Measurements of stream flow are plotted in Figure D5. The stream flow loss between the two weirs measured during the pumping period was 1.2 L/s. In addition, the upstream weir showed a reduction in stream flow during the test of 4.8 L/s, resulting in a total estimated depletion rate for the test of 10.8 L/s $((4.8 \times 2) + 1.2)$.

The test was analysed using these field measurements and the methods described in section 6.1.4 of this guideline. In addition, estimates of streambed conductance were made using gauging surveys (section 6.1.3) and infiltration tests (section 6.1.1). A summary of the test results are presented in Table D1. They show generally good agreement.

These detailed measurements on the Doyleston Drain reflect the magnitude of stream depletion effects that can occur and indicate that the methods of assessment described in sections 4.1 and 6.1 of this guideline are valid techniques to estimate the effect.

Table D1: Results

| | T m²/day | S | sdf (days) | λ m/day |
|------------------------------|--------------------------------------|----------|-----------------------------|--------------------------|
| Drawdown (match point) | | | | |
| - Constant pumping | 1470 | 0.00195 | 4×10^{-3} | 50.3 |
| - Constant recovery | 2680 | - | - | 2.7 |
| - Step | 2420 | 0.00169 | 2×10^{-3} | 16.9 |
| Stream Depletion Match Point | 2070 | 0.00161 | 2×10^{-3} | 7.1 |
| Stream Gauging Survey | - | - | - | 35.6 |
| Infiltration Measurements | - | - | - | 40.8 |
| Geometric Mean | 2070 | 0.0017 | 2×10^{-3} | 16.9 |

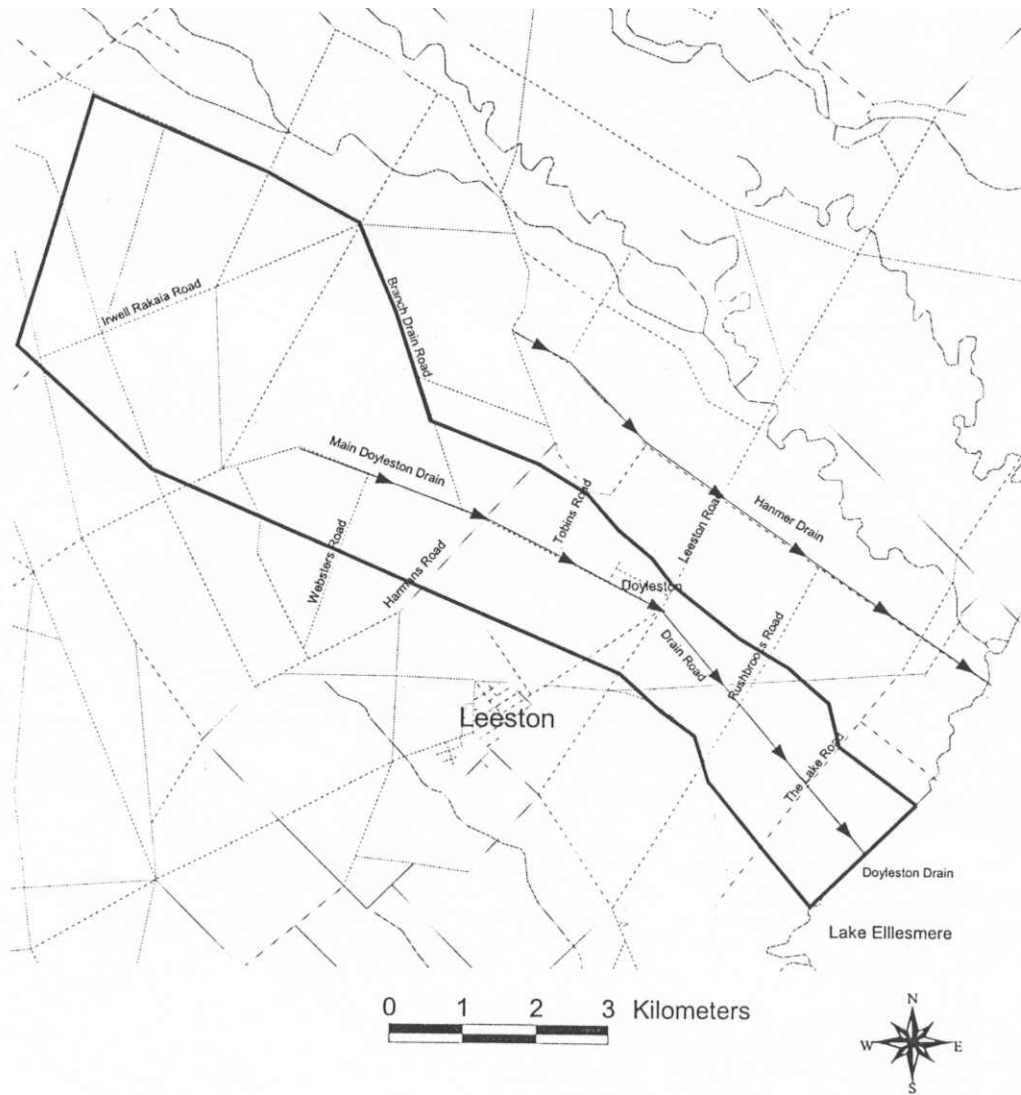


Figure D1: Location Map for Case Study D

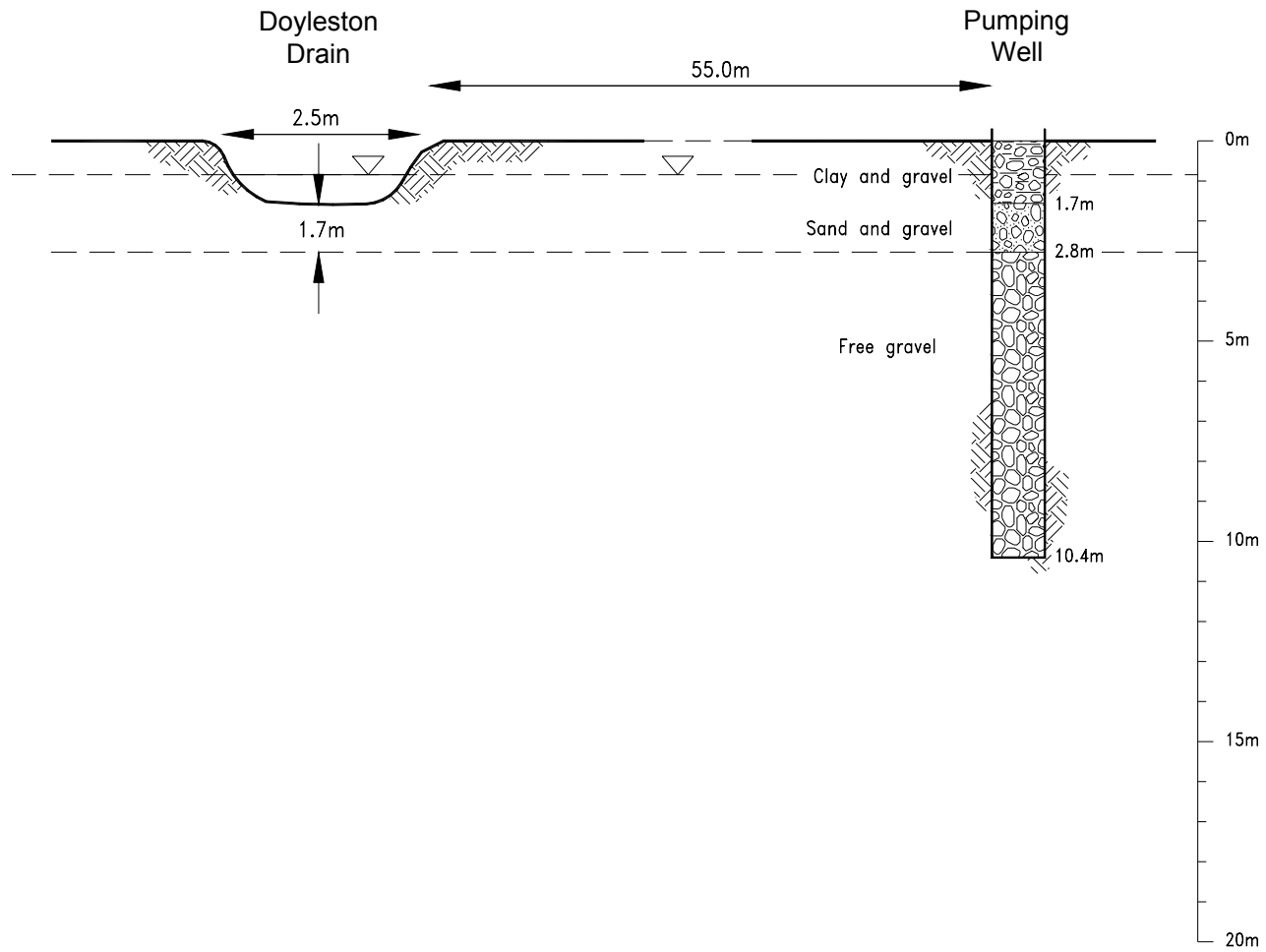


Figure D2: Conceptual Layout of Doyleston Drain Test Site

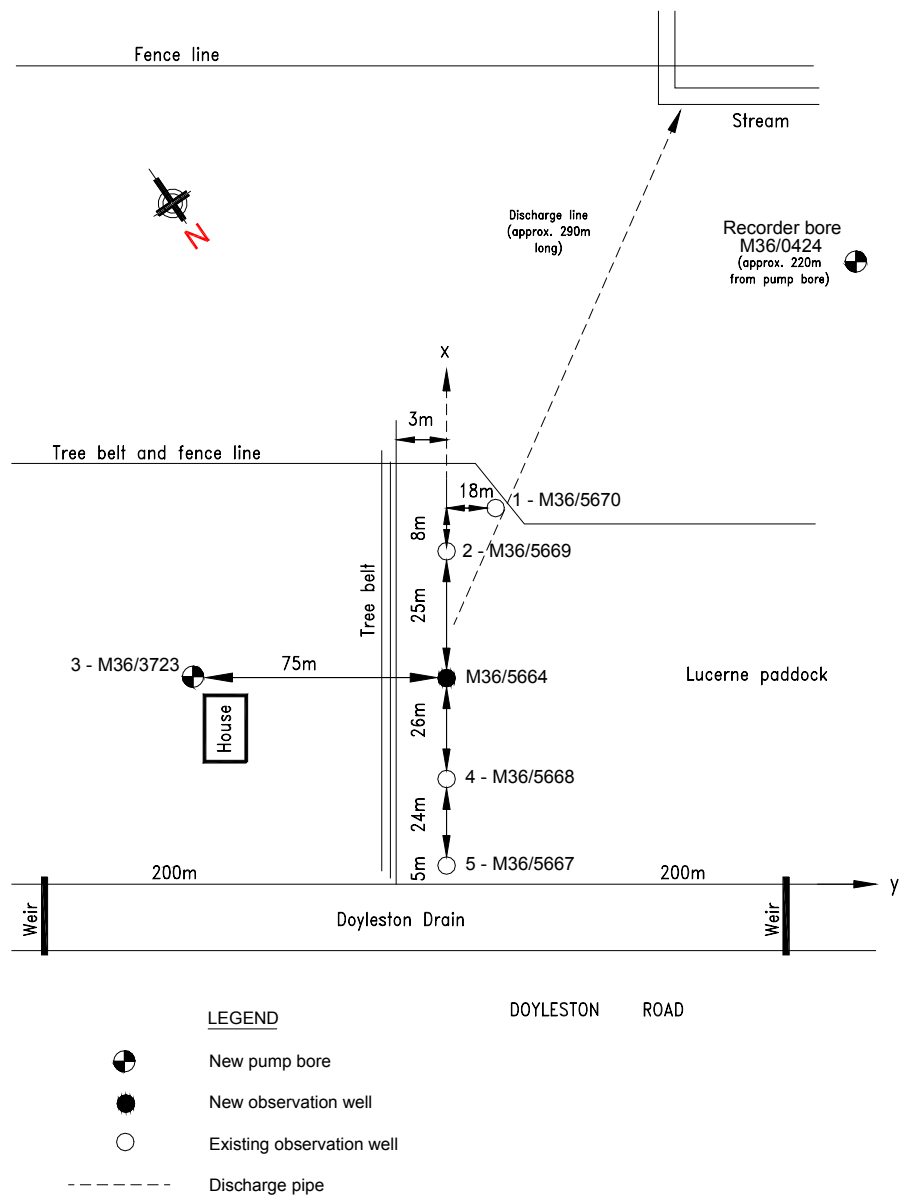


Figure D3: Schematic Layout of Test Site

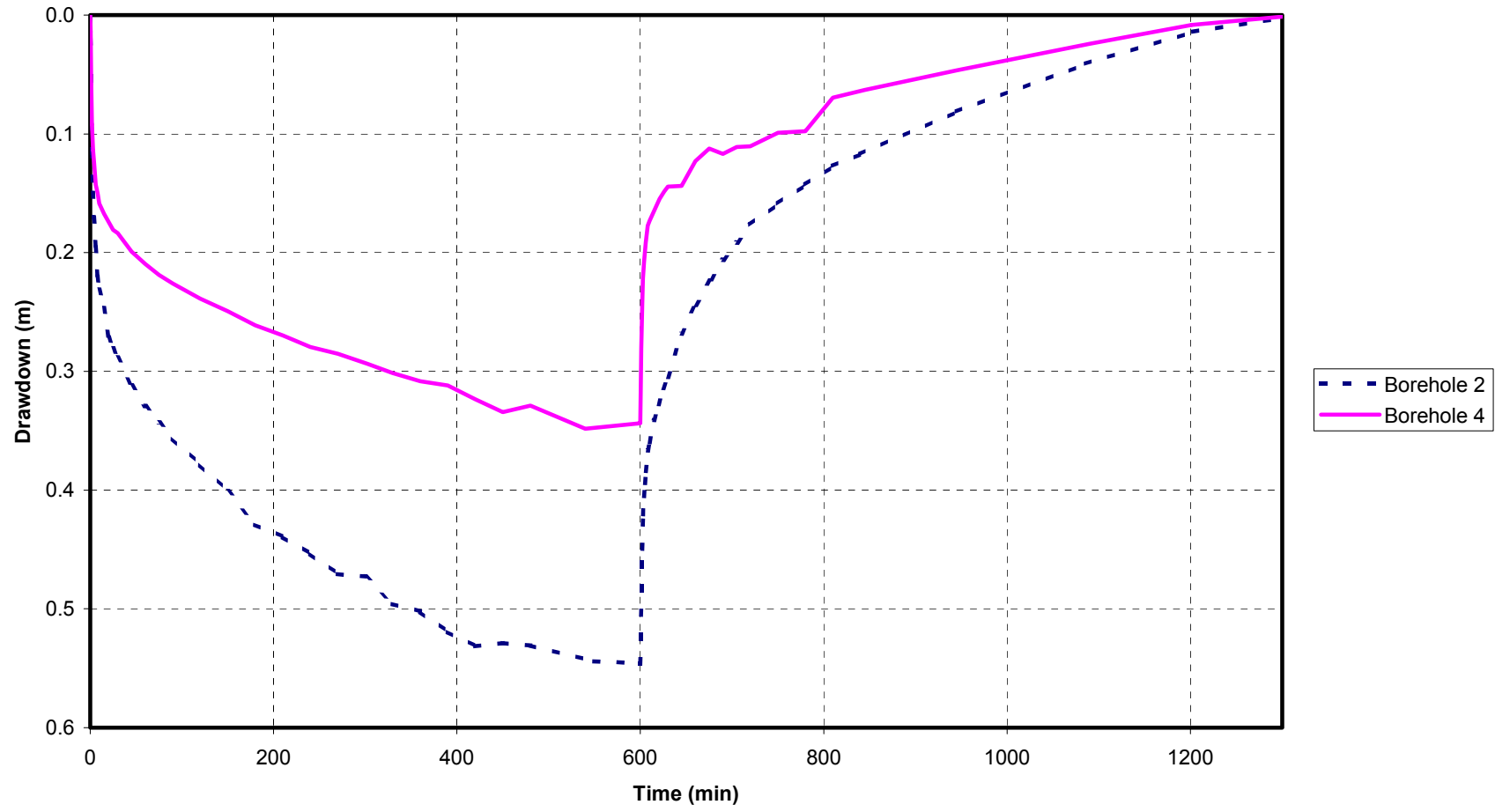


Figure D4: Drawdown in Observation Wells

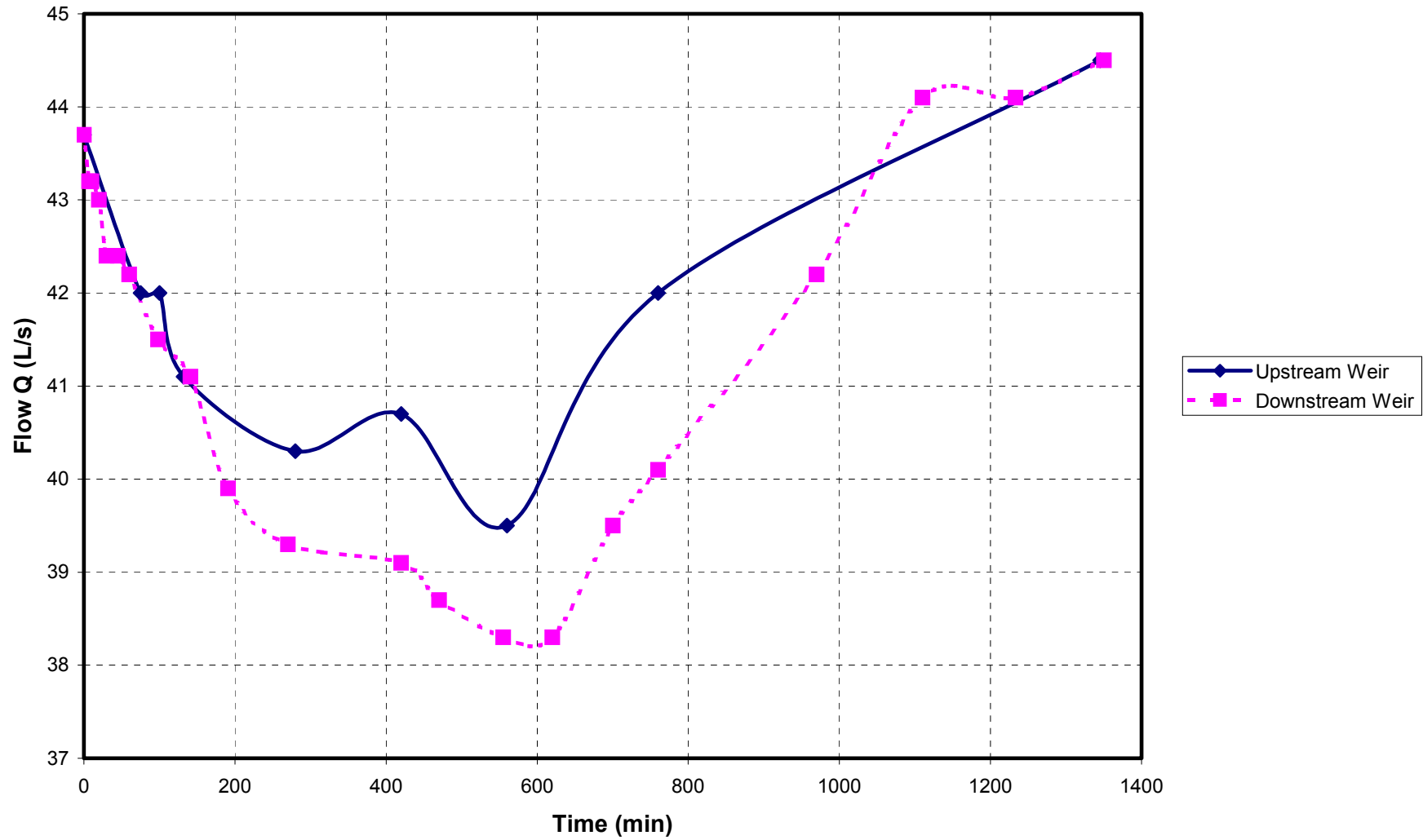


Figure D5: Inferred Change in Stream Flow