Calvinia

Potential for sub-surface storage in a mineralised breccia pipe

Groundwater in the breccia is not fit for drinking:
- high pH (pH 10)
- fluoride (11 mg/L)
- arsenic (0.3 mg/L)

Key question: Will the introduction of surface water dilute the groundwater and bring it to drinking standards? What will the water quality be like after artificial recharge & storage?

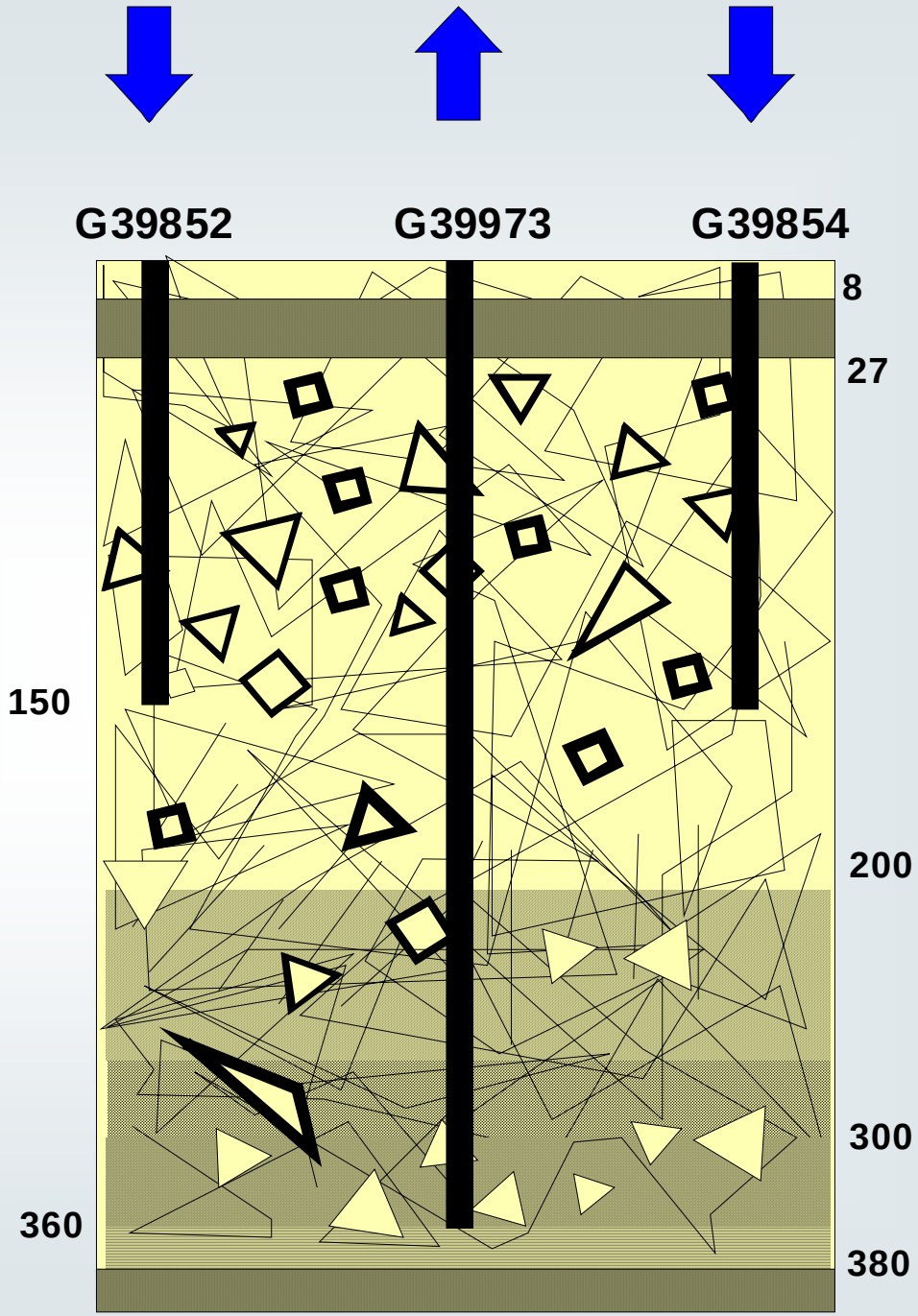
Volumes

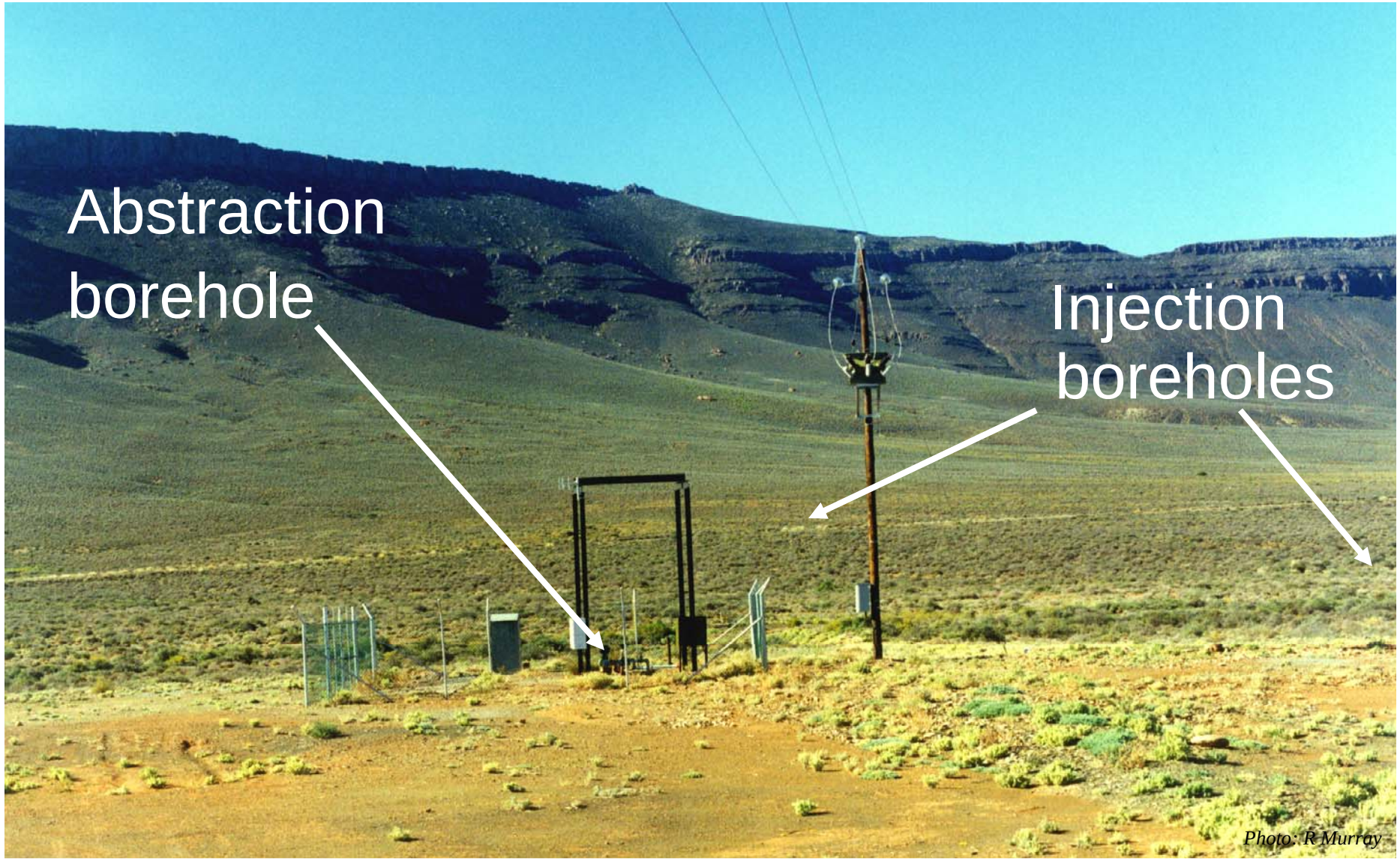
O – 142 m:
48 000 m^3

O – 182 m:
78 – 108 000 m^3

O – 220 m:
94 – 138 000 m^3

Potential to store enough water to supply the town for 3 months



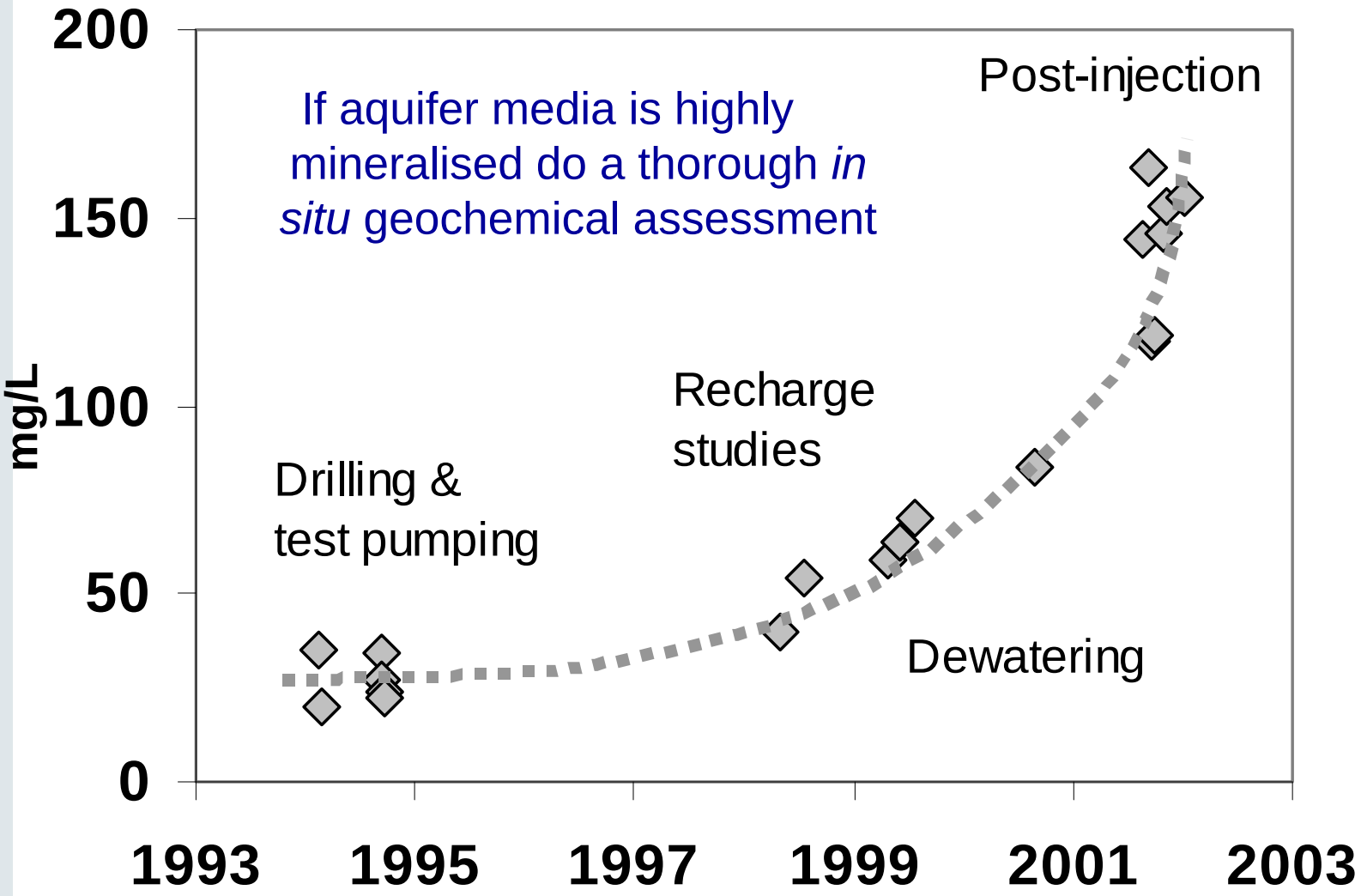

Abstraction borehole
Injection boreholes
Photo: R Murray

- The breccia groundwater is very old (probably over 10 000 years) and has taken a long time to develop this chemistry. It was hoped that, if the poor quality water could be removed and replaced with fresh water, the storage time would not be long enough for the quality to deteriorate.
- Water was pumped out the breccia (48 000 m^3) and replaced with good quality dam water.
- The pH, fluoride and ammonium decreased. Fluoride concentrations in the water can be lowered, since the natural fluoride is predominantly in the groundwater and will be diluted by fresh water over each injection cycle.
- The electrical conductivity, sulphate and arsenic concentrations increased over the short time that the water was stored. This provided a warning that sulphide minerals are being converted to sulphate, dissolving and releasing arsenic and other potentially toxic substances.
- The effect is partly caused by atmospheric oxygen entering the breccia and is very difficult to prevent. Oxygen enters the subsurface when the water table drops each time the breccia pipe is pumped out. Sulphate concentrations have risen since the drilling and test pumping first allowed oxygen into the subsurface and the effect escalated after the injection trials further disturbed the geochemical system.
- Arsenic is released simultaneously with the sulphate, since it comes from the same sulphide minerals.

Water quality – before & after

Units: mg/L	Breccia (pre-AR)	Dam (source water)	Recovery (post-AR)	SABS 241 Class 0 – I
pH	9.8	7.1	9.1	5 – 9.5
EC (mS/m)	89	19	95	<150
Ammonium	1.3	<0.1	0.7	<1.0
Fluoride	10.6	0.1	7.0	<1.0
Arsenic	0.26	<0.001	0.40	<0.05
Sulphate	64	20	157	<400

Sulphate in breccia water



Acknowledgements

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