KINGS CANYON
'FRONTIER RESORT'
Rehabilitation of production
BORE RN 15106

E ROOKE
SENIOR HYDROGEOLOGIST
WATER RESOURCES BRANCH, ALICE SPRINGS

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KINGS CANYON 'FRONTIER RESORT'
REHABILITATION OF PRODUCTION BORE RN15106

BACKGROUND
RN15106, one of two production bores supplying the new Kings Canyon Resort, was equipped on 27th November 1990, approximately two years after its construction. It was recommended to pump at a rate of 10 L/s. Owing to delivery into a temporary small storage tank and lack of electricity, it was equipped for the interim at the rate of 5 L/s using a 'Mono' with foot valve and 100mm column (ie the final design pump) with a diesel drive geared down to the lower rate.

Despite the installation of a permanent larger reservoir in mid-January 1991 the gear drive was not changed and the pump continued to deliver 5 L/s. Recently the pump failed and, upon inspection, was found to be jammed with a mass of rust flakes in the top of the pump. There was only insignificant accumulation of material in the sump and rust pitting of the column.

SITE WORK
Cleaning of the bore was carried out between 1st and 3rd July 1991 using the 'Smeal'.

Briefly the work consisted of five phases:

1. Mechanical swabbing of the 200mm NB casing to 138m BGL using a custom-made circular wire brush. Then total depth measurement.

2. Test pumping to determine any possible decrease in efficiency of the bore. pH measurement.

3. Chemical treatment using a trade product 'Carela
Bio-Plus-Forte' (broad spectrum acid, oxidising agent, biocide, disinfectant).

4. Airlift by duo-pipe from within the sump at the bottom of the bore.

5. High pressure airlift from above the screens within the 200mm NB Casing.

The work method and results thereof are described in more detail below:

1. Total depth upon construction completion (April 1989) = 217.06m. The total depth after mechanical swabbing on 2nd July 1991 was 215.7m. Mechanical swabbing by plunging up and down with a 200mm diameter circular wire brush (stiffened by two washers welded either side of it) cleaned the internal walls of the 200mm NB mild steel casing between ground level and 138mBGL (below which casing size reduces to 150mm NB). The casing was then buffed using a rubber surge block.

A sample recovered on the wire brush showed a sinter deposit of rust flakes. Gauged from the resistance of the plunge action the main zone of pitting/rusting occurred between 109m and 138mBGL. This is the zone of drawdown between SWL and PWL where the bore suffers alternate de-watering/recovery leading to a redox environment in which corrosion potential would be enhanced. A 150mm NB rubber surge block was then run through the 150mm NB casing/stainless steel string from 138m to total depth. This treatment left 2 m of sediment accumulated in the bottom.

2. A short duration step pump test was then done with the pump set at 124mBGL. It was pumped at 6 L/s for thirty minutes, then 10 L/s for one hour. The
results show that the bore has the same efficiency as when it was first test pumped upon its completion. It is deduced that incrustation of the screens has not occurred. Therefore neither iron precipitation nor iron bacteria infestation of the bore has occurred in the intervening period (April 1989 - July 1991). The pH of the water at start of testing was 7.0, and temperature 29°C. It was a dirty grey black colour which cleared after fifteen minutes. At the end of testing the water appeared clear except for minute quantities of silt which consisted of quartz, pyrite, glauconite, limonite(?) and a manganes oxide(?) as well as particles of casing rust. The water de-gassed upon discharge confirming the presence of dissolved carbon dioxide (which acts as a catalyst for corrosion).

3. In view of the lack of incrustation, only a limited chemical treatment was carried out using 100kg of Bio-Plus-Forte at a dilution of 1:10. It was mixed into a 1000L tank by centrifugal pumping and then gravity fed into the bore. It was then left overnight. The next day the bore was swabbed using the 200mm NB wire brush. More sinter was de-scaled from the casings' internal walls.

4. Rust accumulated in the sump was ejected at the surface by means of a duo-pipe system whereby compressed air was jetted under 2MPa pressure down through a 25mm NB GWP and lifted back through a 65mm GWP (the former telescoped through the latter). The ejected water was bronze brown in colour (contaminated from pipe thread grease).

5. The bore was finally airlifted from 128mBGL under very high pressure at about 2L/s for 1¾ hours. pH at the start and end of airlifting was 4.8 and 6.1 respectively owing to chemical residue still in the
bore. Total depth was 216.5mBGL. For the first fifteen minutes the ejected water was extremely dirty; grey black in colour. This gradually improved with less suspended solids present but was still discoloured at the end of airlifting. Under microscopic examination this colour was seen to be imparted by grey clay. Also present was yellowish cream silt composed of quartz, disseminated pyrite, limonite and glauconite.

The rust sinter found earlier was no longer present. The clay and silt material is from the aquifer formation and is fine enough to pass through the 2mm aperture screens. However, it is too fine to cause any mechanical abrasion to the pump.

A precipitate of iron of light yellow colour lined the reservoir. The water in the reservoir comes at present from Production Bore RN15104. It has a strong smell of iron.

CONCLUSIONS

1. Rust sinter has been removed from internal casing walls within Production Bore RN15106 by a combination of mechanical brushing, surging, chemical treatment and airlift to waste.

2. The yield performance of RN15106 has remained the same since its construction and testing two years ago. This indicates that neither incrustation nor bio-fouling of its stainless steel screens has occurred.

3. Test pumping visually confirmed the presence of dissolved carbon dioxide in the groundwater which enhances corrosion potential. The discharged groundwater had an 'iron smell'.
4. Final airlift indicated that the bore is now rust-free. However there is a turbidity problem with light grey clay and yellow/cream silt being suspended in discharged groundwater. This material is too fine to cause mechanical abrasion.

RECOMMENDATIONS

1. RN15106 should be pumped at its originally recommended yield of 10 L/s. This will maintain an up-column velocity of 1.3 m/s, great enough to lift any rust particles (up to diameter about 6mm) to avoid them settling onto the pump intake (at 5 L/s the up-column velocity of 0.6 m/s theoretically could only lift particles of diameter up to 3 mm).

2. Removal of turbidity and iron should be addressed. The iron problem has been solved to some degree by means of nozzled pipes suspended at the top of the inlet reservoir. However, at the time of inspection, these pipes were submerged and hence ineffective. They should be made capable of spraying a water mist suitable to attain maximum aeration. Turbidity (grey colour) may be an on-going problem of groundwater pumped from RN15106. Before addressing this question preliminary observation should be made to ascertain whether the discharged water clears with pumping time (say, one week), and whether the supply delivered through the reticulation system is acceptable. If it does not, rapid sand filtration may be necessary. Treatment processes and procedures are in the realm of PAWA Engineering to advise upon.
3. Before re-connecting RN15106 to reticulation it should be pumped to waste for at least twelve hours. 
(This instruction was relayed to Fred Gray, Construction Supervisor, PAWA Engineering on site on 3rd July 1991 prior to MECS re-installing the pump).

E ROOKE
SENIOR HYDROGEOLOGIST

July 1991
Top of stator-mono pump seized with rust from M.9 casing. April 1991

Pump rods and column - corrosion pitted. April 1991

KINGS CANYON RN 15106

Pump column - corrosion pitted. April 1991
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RN 15106

Airlift development after chemical treatment.
July 1991