

INTRODUCTION

Like any piece of equipment operated for extended periods of time, Collector Wells will undergo changes in operational effectiveness and will occasionally require maintenance. The routine collection of pertinent operating data from the well is critical in developing and maintaining an operating history. By comparison of such data, collected and evaluated over a period of time, it is possible to observe changes in well performance and detect losses in well capacity and many times to determine the cause of such loss. With this data record, maintenance needs can be identified and maintenance work can be budgeted for, scheduled and accomplished at opportune times to avoid sudden breakdowns and minimize service interruption.

Decline in capacity is a common occurrence in most water wells and is primarily caused by the gradual loss of efficiency within the well screens and in the surrounding formation. Following is a discussion of how well loss occurs and the type of records that need to be obtained to evaluate well performance, what the data mean and how it can be used.

CHANGES IN WELL PRODUCTION

When any new well is first installed and developed, its performance and efficiency will be at its peak. Over time, the screen slot openings and the gravel pack and aquifer materials surrounding the screens may gradually become plugged by mineral encrustation, bacterial accumulations and/or migration of fines. This plugging may result in a decline in well capacity. The rate and degree to which this plugging occurs is primarily related to groundwater quality and the rate of water flow through the aquifer and well screen.

EVALUATION OF COLLECTOR PERFORMANCE

Several graphs are useful for monitoring a Collector Well in order to develop operational trends. These will help to identify any changes in well performance or anomalies that may occur during the life of the well and forewarn you of impending situations where well levels may result in less than optimum pumping conditions or where capacity may fall below demand. This will permit any required maintenance to be scheduled at opportune times. Recommended graphs include: Total



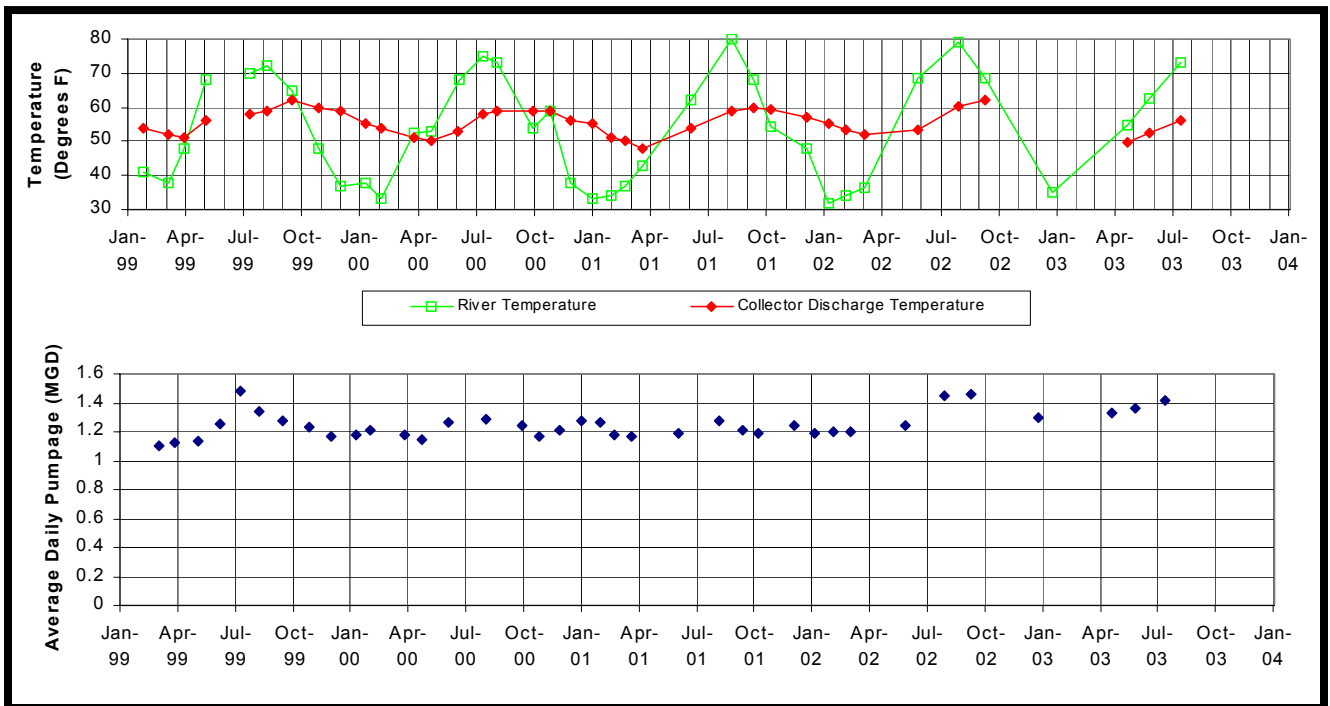
Daily and Monthly Pumpage, Collector Well Pumping Rate, Collector Well Pumping Level, Water Temperature, Apparent Specific Capacity, Differential Drawdown and River Stage Versus Groundwater Elevation. The following paragraphs describe each of these graphs and their use.

Pumpage

Total daily and monthly pumpage is graphed to illustrate the seasonal and yearly production rates from the Collector and can be utilized for future projection of water withdrawal rates as it relates to your usage. The Collector Well pumping rate helps in these projections.

Collector Pumping Level

Graphing the pumping level will illustrate the seasonal variations of the water level in each well as it relates to the factors of pumping rates, river stage, water temperature, precipitation and changes of drawdown with time.



Water Temperature

Plotting the groundwater temperature versus river water temperature will provide base data for future expectations of groundwater temperature. As the temperature varies, the capacity

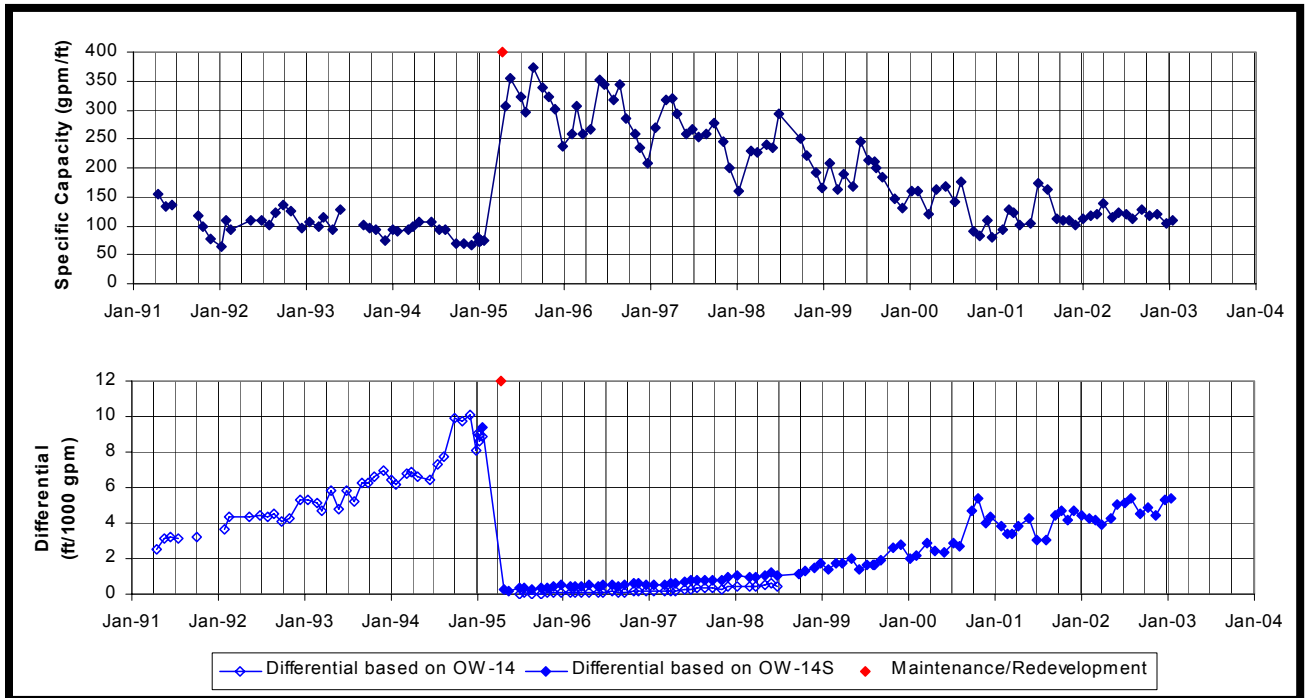


of the Collector will fluctuate due to the viscosity of the water. Viscosity of water is defined as the property that offers resistance to flow, and is expressed as a coefficient of dynamic viscosity or the force required to move a unit area a unit distance. The rate of flow varies inversely as the viscosity; a drop of one degree Fahrenheit in temperature will decrease the flow rate approximately 1.5 percent. As a result, it is important to understand the role of temperature in the overall monitoring process.

Specific Capacity

The apparent specific capacity, or ratio of the pumping rate of each well to its drawdown, is expressed in gallons per minute per foot of drawdown (gpm/ft). Specific capacity depends not only on the transmissivity of the aquifer but also on well construction factors such as screen type, well diameter, degree of aquifer penetration, and completeness of well development. In general, when a well is new or new screens have been installed, the specific capacity will be at its optimum. As production continues, the specific capacity is expected to fluctuate with pumping rate, river stage, temperature, and degree of screen efficiency. If possible, the readings at your well should be obtained when the well is being pumped at a relatively standard pumping rate (approximately the same rate each time data are taken), so that the degree of fluctuation will be largely a result of river stage, temperature and screen efficiency. For this reason, river stage and temperature should also be measured as part of the record-keeping program. Long-term declines in specific capacity are an indication that the well may not be performing as it was immediately following construction.





Differential

One of the most important methods of evaluating well efficiency is to plot the differential between the pumping water level inside the caisson and the water level in the aquifer outside the well. This differential will be greater at greater distances from the Collector. As a result, any observation wells within the radius of the screens can be utilized to determine the relative degree of encrustive plugging in and around the lateral screens with time.

When the well is new, differential will be at its minimum and depend upon the degree of lateral screen development and original well efficiency. If a decline in specific capacity is accompanied by an increase in the differential, the change in specific capacity can be attributed to screen plugging. If a decline in specific capacity is not accompanied by an increase in differential, then the decline may be attributed to dewatering of the aquifer or some other “aquifer-wide” process. To aid in the record keeping process any observation wells in the area should be monitored on a regular basis to evaluate changes in the aquifer outside each well's immediate area of influence.



DATA COLLECTION

A record-keeping monitoring program should include a routine round of measurements and readings sufficient to develop a database and allow the preparation of the graphs recommended above. The measurements should be taken at least once a month during a time when the well is being operated under normal operating conditions, and after the pumps have been running for at least 8 hours so that water level conditions will be stabilized somewhat, and not in a period of transition. Water levels should be referenced to known points of elevation for comparison purposes.

SUMMARY

The above parameters can be utilized to properly analyze and understand the changing conditions throughout the production life cycle of the Collector Well, and enable a general comparison of screen efficiency, aquifer condition, and Collector yield with time. Utilized in conjunction with periodic pumping tests and in-well inspections, where more exact computations and observations of screen efficiency and total yield can be determined, the condition of each Collector will be accurately monitored on a continuing basis.

Supplying water on a continuous basis to your facility is of paramount importance. Considering the investment in a Collector, and the extreme importance of sufficient water supply to the plant the record-keeping program thus outlined will prove an invaluable tool for preventative maintenance throughout the long life of a Collector Well. Please contact us at 614-888-6263 or toll free at 877-4RANNEY (877-472-6639) to discuss potential well monitoring or maintenance programs, including well record keeping, well screen cleaning and redevelopment, and lateral well screen replacement.

