ENGINEERING REPORT

CASE NO. CAP-W-96-1

WATER QUALITY/SERVICE INVESTIGATION

DON OLIASON, P.E.

CAUSE OF CUSTOMER COMPLAINTS

For some years, Capitol Water Corporation (Capitol) has had a moderate iron problem which stained appliances such as dishwashers and clothes washers.  Capitol offered a free chemical called Rover which removed the rust stains and customers generally tolerated the occasional staining.

When Capitol needed additional water supply it drilled what it called Well No. 6.  As soon as the new well began operation several years ago, a more severe rust problem developed.  The cause was the concentrations of iron and manganese in the water coming from Well No. 6 which measured  about 1.3 parts per million (ppm) for iron and about 0.3 ppm for manganese.

Rust problems begin to appear at iron concentrations above 0.3 ppm and manganese concentrations above 0.15 ppm.  Three of the Company’s wells tested around 0.4 ppm for iron which Staff believes were the source of a less severe rust problem prior to putting Well No. 6 into production.

Since it went into production, Well No. 6 has been used only during the high summer consumption period.  After the irrigation season, this well would be shut down and soon thereafter the customer complaints would disappear only to begin again as soon as this well began pumping for irrigation the next summer.

It appears that the extent of the rust problem is almost system wide.  Six wells are scattered throughout the service area but the system is interconnected so water from any well can reach any customer.  However, in the peak of the irrigation season a customer’s water needs would generally come from the closest one or two wells.  Because of their location, Well Nos. 4 and 6 supply the peak demand for the western half of the service area, and with 60% of the total production capacity these two wells likely serve a portion of the eastern half.  The other four wells, located in the eastern half of the service area generally supply peak demand for the eastern portion.  The iron problem caused by Well No. 6 is expected to be most noticeable in the western and middle portion of the service area affecting roughly 60% of the customers.  However, two of the wells in the eastern portion of the service area have enough iron content to cause a rust problem although a less severe problem.  Well Nos. 3 and 5 have such low iron concentration that customers who live near these two wells may have no rust problem at all.  Of the complaints recorded by the Consumer Division during the summer of 1996, about 30% were from customers located in the eastern portion of the service area.

There is not sufficient data to allow an estimate of the percentage of customers who do or do not have a rust problem.  Staff can only provide an educated guess which is that over half of the customers suffer rusty water in the summer caused primarily by Well No. 6.  If one considered shutting down Well No. 6, all customers would suffer low pressure.

IRON AND MANGANESE AS VIEWED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

The EPA establishes what it calls Secondary Maximum Contaminant Levels (SMCLs) which it considers to be tolerable concentration levels of various substances in drinking water based on such things as taste, odor or appearance.  The SMCLs are not mandated by EPA but are given as guides.  Some of these substances, such as iron and manganese, are essential to human health in certain quantities but their rust producing qualities can produce objectionable drinking water.

The SMCL for iron is 0.3 ppm (or milligrams/liter).  Above this concentration rust begins to form and this objectional feature increases as the concentration of iron increases.  A normal human diet contains an average of 16 milligrams of iron per day.

The SMCL for manganese is 0.05 ppm (or milligrams/liter).  Above this concentration manganese oxide begins to coat piping.  If the coating sloughs off it can cause brown blotches on laundry and black precipitates.  A normal human diet contains an average of 10 milligrams of manganese per day.

IRON AND MANGANESE CONCENTRATION IN CAPITOL’S WELLS

Well No.Iron (ppm)Manganese (ppm)

        1      0.300.30

    2      0.401.60

    3      0.010.01

    4      0.150.15

    5      0.010.03

    6      1.300.30

These numbers are representative of the concentrations in each well; however, the concentrations change from time to time by as much as 30%.

COMMON METHODS FOR RESOLVING RUST PROBLEMS CAUSED BY IRON AND MANGANESE

A.   Oxidation and filtration:  Water is mixed with air to oxidize the iron and manganese followed by filtration to remove the oxides.

B.   Drill a new well and locate an aquifer with low concentrations of iron and manganese.

C.   Sequestration:  If the total concentration of iron and manganese is less than about 1.0 ppm, small quantities of polyphosphate can be used to hold the iron and manganese atoms so they cannot oxidize and turn into rust.  Polyphosphate is a manufactured large molecule of phosphate which has an affinity for iron and manganese atoms.

TO CURE CAPITOL WATER’S RUST PROBLEM

Capitol retained Scanlan Engineering to develop and evaluate various methods for alleviating the water systems rust problem.  Attached to this report is a copy of the Scanlan Engineering report labeled Attachment No. 1.

The options for alleviating the rust problem are:

Annual

OptionCapitol CostAdded Operating Cost

1.   Drill a new well (1,500 - 2,000 gpm)$   300,000$0

2.   Sequestering with Polyphosphates $     15,000$10,000

3.   Purchase water from United Water$     50,000$0 - $200,000

4.   Install customer meters$1,000,000$50,000

5.   Oxidation and Filtration$1,500,000$75,000

Scanlan considered water conditioning (filtering and softening) but didn’t list it as an option because of excessive cost.  Also mentioned were home water conditioners because they can be very effective in removing iron and manganese.  Cost for a homeowner would be $500 to $2,000.  It was not considered as an option because it is outside the control of Capitol.

Oxidation and filtration is a very effective way to remove iron and manganese from a water supply but it costs five times the cost of a new well and is clearly too expensive.  Installation of customer meters has been discussed at length by Staff.  It is well known that when a water system converts from a flat rate to individual meters and a metered rate, the summer consumption declines significantly.  However, the cost to install meters is twice the cost of a new well and one can not predict accurately if the reduction in usage would replace the capacity of Well No. 6.

The purchase of water from United Water Idaho is clearly an option but Staff does not recommend it.

Sequestering is clearly the most economical method when the iron and manganese concentrations are low enough for it to work.  We know from the trial in the summer of 1996 that sequestering did not work for Well No. 6 so it is not a workable option.  However, Staff believes it should be used at several existing wells where the metal concentrations are in the workable sequestering range.

Scanlan recommends that a new well will be the most effective and economical of the five options.  Also recommended is drilling a test well first to test different aquifers for desirable low concentrations of iron and manganese.  If the rust problem is to be cured, Staff agrees that drilling a new well is the best option.

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Don Oliason, P.E.

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