AN OVERVIEW OF A WATER QUALITY MONITORING IN WATER SUPPLY SCHEME: A CASE STUDY ON IRON PRESENT IN GROUNDWATER WELLS IN VALLIPURAM, JAFFNA

Conference Paper · July 2015

CITATION
1

READS
202

3 authors:

Saravanan Suntharalingam
National Water Supply and Drainage Board
36 PUBLICATIONS **155** CITATIONS

SEE PROFILE

(Mrs.) Thushyanthy Mikunthan
University of Jaffna
76 PUBLICATIONS **424** CITATIONS

SEE PROFILE

Gunaalan Kuddithamby
Technical University of Denmark
25 PUBLICATIONS **94** CITATIONS

SEE PROFILE

AN OVERVIEW OF A WATER QUALITY MONITORING IN WATER SUPPLY SCHEME: A CASE STUDY ON IRON PRESENT IN GROUNDWATER WELLS IN VALLIPURAM, JAFFNA

S.Saravanan[1] Thushyanthy Mikunthan[2] K.Gunaalan[3]

[1]National Water Supply and Drainage board
[2]Dept. of Agric. Engineering, Faculty of Agriculture, University of Jaffna
[3]Dept. of Fisheries Science, Faculty of Science, University of Jaffna

Abstract

Drinking water is one of the basic needs of life and essential for survival. Iron is a harmless element in the groundwater, though sometimes annoying element present in water supplies. Iron is primarily component of groundwater with the characteristic of staining properties, although high levels can impart a bittersweet or metallic taste to drinking water. In case of Jaffna Peninsula, it is fully depend on groundwater for drinking, agriculture and industry. The quality of groundwater is getting deteriorate due to many factors. The National Water Supply and Drainage Board (NWS&DB) have several schemes to supply the water where water under scarce and unacceptable quality.Under the Asian Development Bank fourth project, Point Pedro water supply scheme has been started with the construction of four collector wells as a water source. Each well is having 150 m long slotted stainless steel lateral pipes to increase the capacity. Currently the concentration of iron plays the crucial role in supply of the scheme. Prior to construction of wells there was no any issues observed and the Iron concentration was varied 0.00 to 0.22 mg/L during bore hole testing in 2010. Later in 2012 the iron concentration was observed as 0.76 mg/L, also the water sample contained brownish suspended matters and sediments. But in 2014 after completion of well construction the situation was totally altered and the maximum iron concentration pointed as 4.6 mg/L and also brownish scum was observed in those wells due to the iron bacteria activity. The increasing trend of iron concentration was observed in the wells. Still the adjacent wells don't have iron problems. Hence NWS&DB did several well cleaning, lateral pipe cleaning works, shock chlorination and continuous pumping to improve the quality as management practices and now the iron concentration was reduced up to accepted level as 0.1 to 0.2 ppm in distributed water.

Introduction

Groundwater resources play a vital role in the production of clean and adequate drinking water supply all around the world. The extensive use of groundwater can be explained by the ease of access, better protection from pollution sources, higher water quality as compared to surface water, less subject to seasonal and perennial changes, uniformly spreading over large areas and also lower capital cost of production. These benefits have resulted in groundwater use for water supply at large scale. The Jaffna peninsula is located in the Northern Province of Sri Lanka.

Groundwater is the only the prime natural water source for domestic, agricultural and industrial purpose in the Jaffna. Groundwater contamination play crucial role in the quality and the supply of water in the Peninsula also it can pose serious threat to human health. Groundwater can be contaminated by different sources mainly due to human activities that include point and non-point sources. Moody (1996) stated that the most common sources include waste disposal practices, storage and handling of materials and waste, saline water intrusion and agricultural activities.

Iron and Manganese can be occur naturally in groundwater. Foster (1985) observed that iron and manganese are common elements in the earth‘s crust and as water percolates through soil and rock it can dissolve these minerals and carry them into groundwater. It may direct result of underground rock formations and precipitation water that infiltrates through these formations (Ahmad, 2012). Iron and manganese are non-hazardous elements that can be a nuisance in a water supply (Oram, 2012). Dissolved iron concentrations do not have any serious harm to human health (Ahmad, 2012) but these dissolved irons when oxidized by oxygen can cause aesthetic problems thus reddish brown solid particles formed and color of water altered. Environmental Protection Agency stated that iron in quantities greater than 0.3 mg/l in drinking water can cause an unpleasant metallic taste and rusty color.

Statement of the problem

The National Water Supply and Drainage Board (NWS&DB) have several schemes to supply the water where water under scarce and unacceptable quality.Under the Asian Development Bank fourth project, Point Pedro water supply scheme has been started with the construction of four collector wells as a water source. Each well is having two, 150 m long slotted stainless steel lateral pipes to increase the capacity. The base of the collector well is cemented and act as a storage sum. The water is received to collector wells only from recharged water through two lateral pipes. Currently the concentration of iron plays the crucial role in supply of the scheme.

During the initial investigation period, 2010 October, some testing bore holes were constructed by Groundwater section and did the yield test. Also water samples were collected from these bore holes for water quality analysis. The results showed that qualities of the water from the bore holes were satisfied and the concentration of iron was only 0.00 to 0.22 mg/l. In July 2012, as per

the project office request, water quality survey was carried out in well 01 and some surrounding wells in the intake site. Again the results showed that there were no any significant quality problems.

In October 2012, Project Engineer sent a water sample to NWS&DB for water quality analysis because they were observed some unknown suspended materials in the well. The quality of water was checked and found that the presence Iron concentration as 0.73 ppm. Also there were lot of brownish suspended matters (like sponges) and sediments in the sample bottle. But prior to construction of wells there was no such issues observed.

After the completion of construction of wells, in March 2014, the quality of the water was checked. The maximum of 4.6 ppm of iron concentration was observed. Brownish scum was observed in well No 02, 03 and 04. All wells showed high concentration of Iron. Comparably well 04 & 03 had shown high concentration of iron than well No 01 & 02. Due to this iron problem, Groundwater section and Project office did several well cleaning works and continuous pumping to improve the quality. Anyhow, the iron concentration was not reduced as expected. Hence the study was conducted to identify the level of contamination of iron in those wells and try to mitigate the problem with different experiments.

Methodology

Collection of water sample

The four production wells and an observation well were selected as sampling point. Sample was collected for a week from May 28th 2014 to 3rd June 2014. The water samples were collected during the 12 hours of continuous pumping. And observation well was used as a control. Samples collected from top and bottom of the well water. Top water sample were collected from 10 cm below the surface. Specific sampler was used for sampling. Samples were collected from all wells in the following time, 6.00 am (before pumping), 12.00 noon (from well No 04 after stopover of pumping), 3.00 pm (from well No 03 after stopover of pumping) and 6.00 pm (from well No 01 & 02 after stopover of pumping)

Chemical analysis

Water samples were analyzed for pH (pH meter), electrical conductivity (EC meter), DO (DO meter) and total iron (Spectrometry) based on Sri Lanka standards 614: part 1 (2013) and APHA method on the field.

Treatment

Continuous flushing was carried out and chlorination also was done at night time to reduce the high concentration of iron.

Results and discussion

Table 01 shows the treatment given to the different wells as continuous pumping, cleaning and chlorination for seven days. The observations from all the wells were summarized as remarks. The figure 01 shows the changes in the iron concentration in the well in well no 1, 2, 3 and 4 respectively water due to the different treatment. The iron concentration was observed in range of 0.60 to 10.80 ppm before staring the pumping test. However the iron concentration was reduced to certain extent which was near or less than Sri Lankan standard value of 0.3 mg/l.

Figure 02 shows the electrical conductivity variation during the pumping. It varies in the range of 421 µS/cm to 1068 µS/cm. There is no addition or removal of elements/ion due to our treatment in all the wells during the study period and all the values were less than the SLS permissible level.

Table 01: Observations from four wells

	Well No 01	Well No 02	Well No 03	Well No 04	Remarks
DAY 01	Less concentration of Iron.	Less concentration of Iron.	High concentration of Iron	High concentration of Iron	During the pumping, Iron concentration was reduced.
DAY 02				Well No 04 was cleaned, after the cleaning, well water became dark and very unpleasant. From the lateral pipe the water came likes sewage water (very dark and odour)	Unpleasant odor was felt. It may be due to H_2S smell. Well transparency was very less in well No 04.
Day 03		Well was cleaned	Well was cleaned Same odor and transparency problems were observed After pumping well was super chlorinated	After the pumping hours well was super chlorinated	Thin oil type layer was observed in well No 02, 03 & 04.
Day 04		The thin oil type layer which was observed in Day 03, got thick			All Wells showed unpleasant odor, Iron concentration was reduced in all wells. Transparency is very less in all well, wells appeared very dark in color Odor level was increased in all wells.
Day 05	Iron Concentration was reduced in all well.				
Day 06	Iron Concentration was reduced in all well				
Day 07	Iron Concentration was reduced in all well				

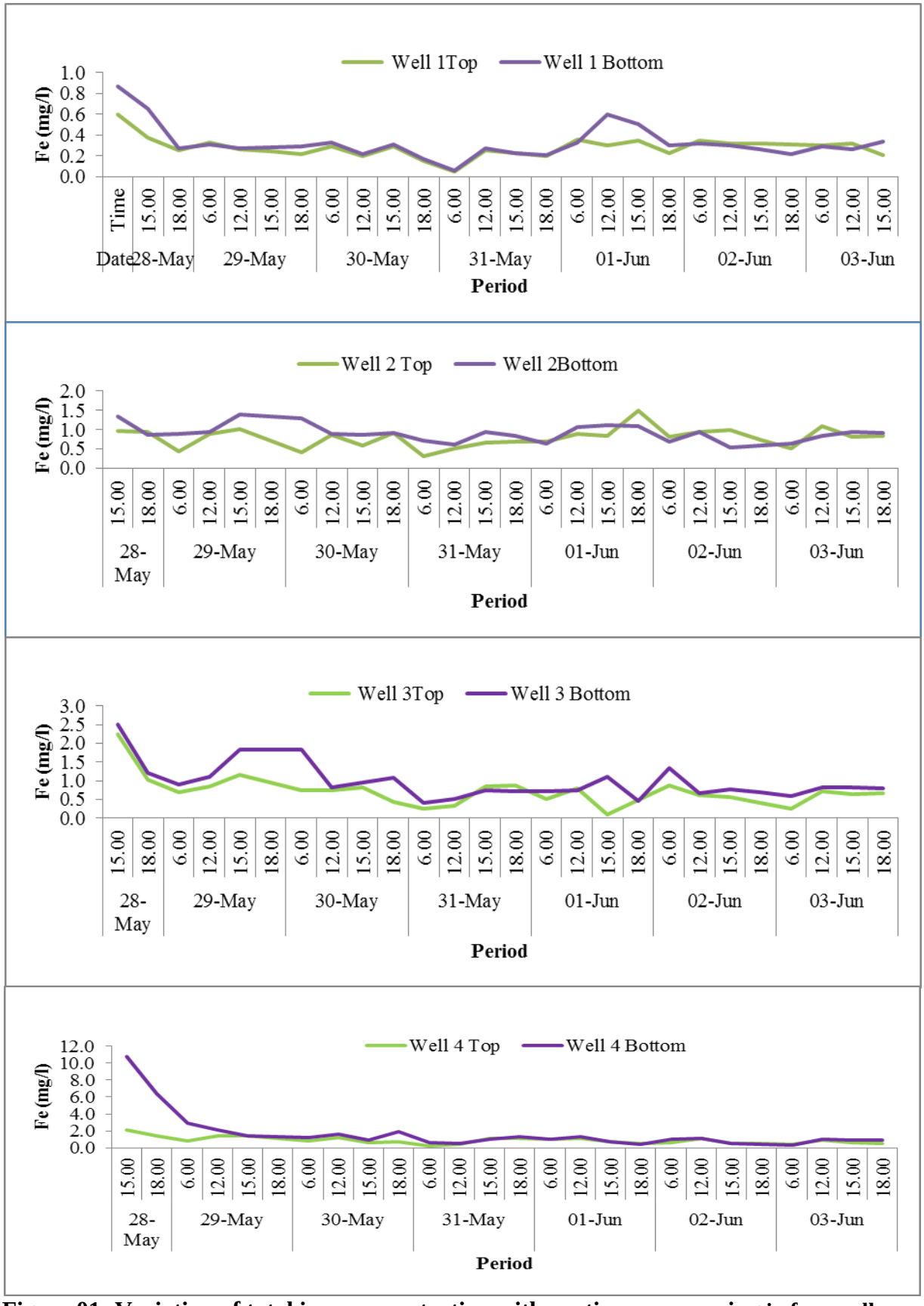

Figure 01: Variation of total iron concentration with continuous pumping in four wells

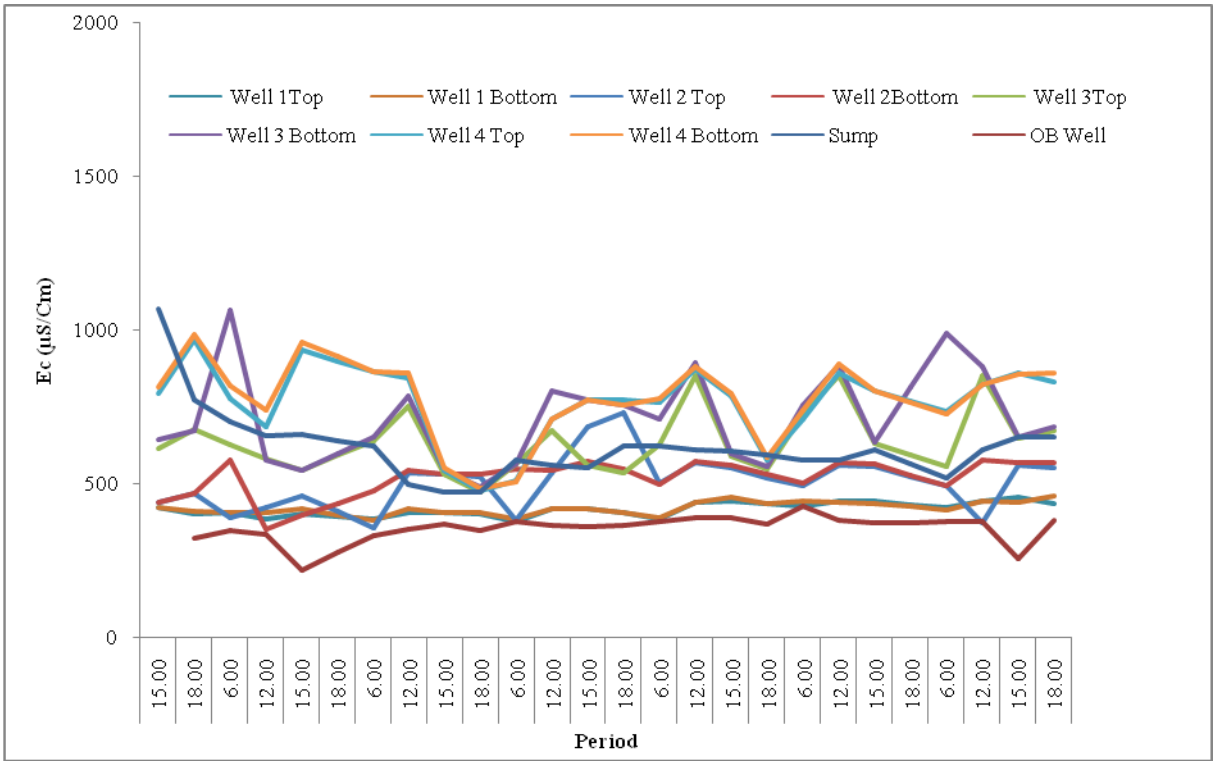

Figure 02: The electrical conductivity of the water

The value of the DO ranges from 1.8 mg/l to 8 mg/l. The DO of observation well was high. It may be due to the influence of the wind because the water level is very close to the atmosphere.

Conclusion

Continuous pumping was given a good feed back and iron concentration in the pumping water was in the acceptable limit. Due to the continuous pumping no significant changes in the electrical conductivity in all wells, resting time may cause the saturation iron in the well and formation of iron bacteria. Continuous pumping and the chlorination is the recommended treatment to the above wells to produce a sustainable water quality. The adjacent well didn't show iron concentration problem and this production wells only showed the iron problem. Hence further investigation should be needed to identify the source of iron contamination in these wells.

Reference:

Ahmad, M. (2012). *Iron and manganese removal from groundwater*. M.Sc. Department of Geosciences, Faculty of Mathematics and Natural Sciences, University of Oslo.

Epa.gov, (2015). *Iron | Corrosion, Scaling, and Metal Mobility Research | US EPA*. [online] Available at: http://www.epa.gov/nrmrl/wswrd/cr/corr_res_iron.html [Accessed 11 Jun. 2015].

Foster, S.S.D. (1985). Groundwater pollution protection in developing countries. In: G. Matthess, S.S.D. Foster and A.C. Skinner [Eds] Theoretical Background, Hydrogeology and Practice of Groundwater Protection Zones. IAH International Contributions to Hydrogeology Volume 6, pp: 167-200

Moody, W. (1996). Sources and extent of groundwater contamination. U. S. Geological survey

Oram, B. (2015). *Water Testing Iron Manganese Rusty Water Red Black Staining*. [online] Water-research.net. Available at: http://www.water-research.net/index.php/iron [Accessed 11 Jun. 2015].

Sri Lankan drinking water quality Standards 614 part 1(2013)