ParagraphS
Paragraphs Environmental Design

Original Research

DOI : 10.59260/penvid.2023.01101317

OPEN ACCESS

ASSIGNED EDITOR
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RECIVED: 13 January 2023
ACCEPTED: 17 June 2023
PUBLISHED: 26 July 2023

CITATION
Alfiah T, and Caroline J.(2023). Total Suspended Solids (TSS)-Spatial Distribution of Manganese in Resident Well Impacted By Residential activity : A Case Study of Medokan Ayu District-Surabaya.Paragraphs Environmental Design
DOI : 10.59260/penvid.2023.01101317

Total Suspended Solids (TSS) Spatial Distribution of Manganese in Resident Well Impacted by Residential Activity: A Case Study of Medokan Ayu District-Surabaya

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Abstract

TSS (Total Suspended Solid) is an optical turbidity parameter to assess water quality and provide essential information for the water environment. Particularly, the degradation of watersheds creates immense pressure on water quality, especially in arid and semiarid regions. However, concentrations of TTS in water are also due to the effects of pollution, and activities on the surface. Therefore, factual information regarding determining the effective depth of TSS is essential for the estimation of the water column. To address this problem, we collected 100 water samples from 10 different sites of the wells at Medokan Ayu District, Surabaya (Indonesia). To investigate the TSS concentrations. The results showed that the quality of well water for the turbidity parameter did not exceed the standard of clean water quality, where the highest value was found in well 7: 17.97 NTU, for the Manganese parameter in wells that exceeded the quality standard, it was found in Well 2: 1.4 mg/L. , well 5: 1.7 mg/L, well 6: 1.8 mg/L, well 7 : 8.6 mg/L and well 9: 4.3 mg/L. Well TSS parameters that exceed quality standards are found at Well 1: 1,200 mg/L, Well 3: 1,200 mg/L, Well 5: 800 mg/L, Well 6: 1,600 mg/L, Well 7: 1,600 mg/L, Well 8 : 1,200 mg/L, Well 9 : 1,200 mg/L, and Well 10 : 1,200 mg/L. The pattern of distribution of pollution levels using surfer software mapping, three wells have the highest concentrations of Manganese, TSS, and Turbidity found in wells number 6, 7, and 9.

Keywords: TTS, Water Quality, Watersheds, Environtment, Surface.

1. Introduction

Leads to an oxidized form in ferric hydroxide ($Fe(OH)3$) (Qin et al., 2019; Nguyen et al., 2020). In daily life, oxidation of iron ($Fe2+$) in groundwater causes a transformation of a yellowing mark on the material that has been used. This impact is part of the cumulative amount of total suspended solids (TSS) of sediment-forming material that increases very rapidly during the disturbance of sediments in rivers or floods (Robinson et al., 2018). The suspended particles in water interfere with light causing turbidity (cloudiness) of the water leading to insufficiency of photosynthetic activity of marine plants, both micro, and macro (Hardiana et al, 2019).

In terms of water quality, the numerous TTS on groundwater has deteriorated water quality (Mustafa et al., 2021; Ghosh et al., 2020). In Indonesia, currently, water quality faced this challenge, moreover environmental characteristics such as frequent flood disasters, inadequate water waste management treatment (WWMT) infrastructure, and poor household sewerage (Somura et al., 2019) dan (Sutadian et al., 2018). Several studies have been highlighted in regard to TTS numbers in certain conditions. Such as Parwati & Purwanto (2017) reported in 10 sites coastal area with time series 20 years analysis showed a very dynamic increase number of TSS. Furthermore, Adawiah et al., (2021) study, perform forecasting TSS numbers with ARIMA (Autoregressive Integrated Moving Average) with a dataset in Cikapundung River from 2017 to 2018.

The study describes the number of TTS high possible increasing intensives for the next 5 years. However, at thus far, all related studies used primer water current as a site study of TTS amount. Therefore, it is necessary to monitor the TTS amount in water resources to better trement for improved life quality.

In Indonesia, people most commonly use well as resources of water for daily life purposes. But is still rarely found studies on the amount of TTS in well water. Hence, it is necessary to identify the TTS amount in well water, which is used as a daily resource of fresh water.

Through, the present study, we aim to determine the feasibility of well water and examine the relationship between environmental factors. In aspects, the distance of the pollutant source to the-well, the number of pollutant sources within the well, the physical condition of the well, and the type of well with the quality of the well water.

2. Method and Material

2.1 Study area

The study was conducted on the scale of Medokan Ayu districts of Surabaya city East-Java, for the coordinates can be seen in the Table 1. The criteria for selecting the study area were based on the household population density, with population of 27.980 souls. which is one of the largest districts in Surabaya city.

And, near a coastal area circa (435 km) making the site area highly possible reciprocal contamination. From 170 wells, 10 wells are selected with In more detail, for all the wells in Medokan Ayu area will be taken for testing the geographical location of the study area is present in Fig. 1, and coordinate mapping is in Table 1.

2.2 Data Collectiona and Analysis Data

The samples were collected in 1-liter in each with their well water location (Table 1), then keep in deionized polyethylene (PE) bottles with numbered from 1 to 10. Due to wide distribution sampling area the collection was twice at different weeks. These sample bottles were sealed and placed in a dark environment at a constant temperature range of 4–10°C to avoid any contamination and the effects of light and temperature.

For water quality analysis of collected water samples including Mn, total suspended solids (TSS), total dissolved solids (TDS), turbidity, and conductivity, a representative water sampling was carried out from each location. All chemical analysis were perform by environmental quality laboratory in Adhi Tama Institute of Technology Surabaya. At the end, all data will be visualization into geoelectric mapping 2D with Surfer software application version 8.0.

3. Results and Discussions

3.1 Spatial Distribution

The research location is in a well in the coastal area of Surabaya, in the Tambak Medokan Ayu area, Rungkut sub-district, Surabaya. The sampling points of 10 different points were determined based on the distance of the wells. The sampling time was carried out in the afternoon. Water-

Fig. 1. 2D illustrated point under variation of sampling area

Table 1. Coordinate location under specified point wells

No	Wells	Description	Point
1	s1	Well 1	7°19'10.95"S / 112°47'42.83"T
2	s2	Well 2	7°19'32.79"S /112°47'51.93"T
3	s3	Well 3	7°19'33.17"S /112°47'54.38"T
4	s4	Well 4	7°19'34.35"S /112°47'54.09"T
5	s5	Well 5	7°19'36.67"S / 112°47'52.18"E
6	s6	Well 6	7°19'42.22"S / 112°48'7.05"T
7	s7	Well 7	7°19'36.19"S / 112°48'18.38"T
8	s8	Well 8	7°19'33.20"S / 112°47 '9.60"T
9	s9	Well 9	7°19'41.33"S / 112°47'40.03"T
10	s9	Well 9	7°19'47.89"S /112°47'43.05"T

-samples were analyzed at the Environmental Quality Laboratory of the Adhi Tama Institute of Technology Surabaya. The selection of the location of the well water sampling point in this study was carried out by considering the criteria requirements, namely, well water that is still used for daily life.

3.2 Mn Analysis of Groundwater Quality

Water well dug in the risk area is contaminated with Mn from wastewater from the surrounding area and soil containing Mn around the drilled well. Mn with concentrations exceeding the quality standard will cause nervous system disorders and affect brain function. The signs of the emergence of-

-diseases caused by Mn poisoning are known slowly and can even extend over months or years.

The most severe type of disease resulting from Mn poisoning is in the form of permanent damage to the nervous system, such as Parkinson's disease, where the sufferer feels nervous, has difficulty walking, and stiff facial muscles. The appearance of this disease is sometimes characterized by physical symptoms such as being very sensitive, loss of ability to move, and frequent hallucinations. The Mn test was carried out at each predetermined well location in this study. The results of the observation sample can be seen in Figure 1 distribution of Contamination Mn. in this research, mapping the distribution of Mn in Region Medokan Ayu, where the mapping results can be seen in Fig. 2.

Fig. 2 describes that white-colored and white-yellowish on the map meet the quality standards, then colored dark yellow to black does not meet quality standards. From the above picture can be seen that some of the sample points that have pollution Mn high or exceed the quality standards contained in wells 2, well 5, well 6, well 7, and well 9, and we can compare the colors included in the map, the higher the level of pollution, the color pattern will be different. Change where the wells below the quality standard or meet the quality standard on-the map are white and yellowish-white, while the wells that do not meet the quality standard are dark yellow to dark red or close to black.

Based on the results, the level of Manganese pollution for each well sample that is high or that exceeds quality standards can be compared with the Minister of Health Regulation Number 32 of 2017. The recommended water requirement is 0.5 mg/L. The results of the manganese parameter values in this study were between 0.1 - 8.6 mg/L and wells that exceeded quality standards were found in Wells 2, wells, 5 wells 6, wells 7, and wells 9. The higher the manganese value, the worse the quality of the water. Well water in the Medokan Ayu area has the lowest value in wells number 3: 0.3 mg/L, 4: 0.4 mg/L, 8: 0.1 mg/L and 10: 0.1 mg/L. L. Meanwhile, well water that exceeds quality standards is found in Wells 2, 5 wells 6, wells 7 and well 9. The high content of Manganese in the Medokan Medokan ayu location can be caused by the well water used coming from groundwater that is densely populated so that contamination is possible groundwater sources from drainage canals. In addition, poor manganese values can be caused by contact with groundwater which is caused by (1) poor well construction such as cracked well floors and proximity to latrines and drainage/drainage channels, and (2) the presence-

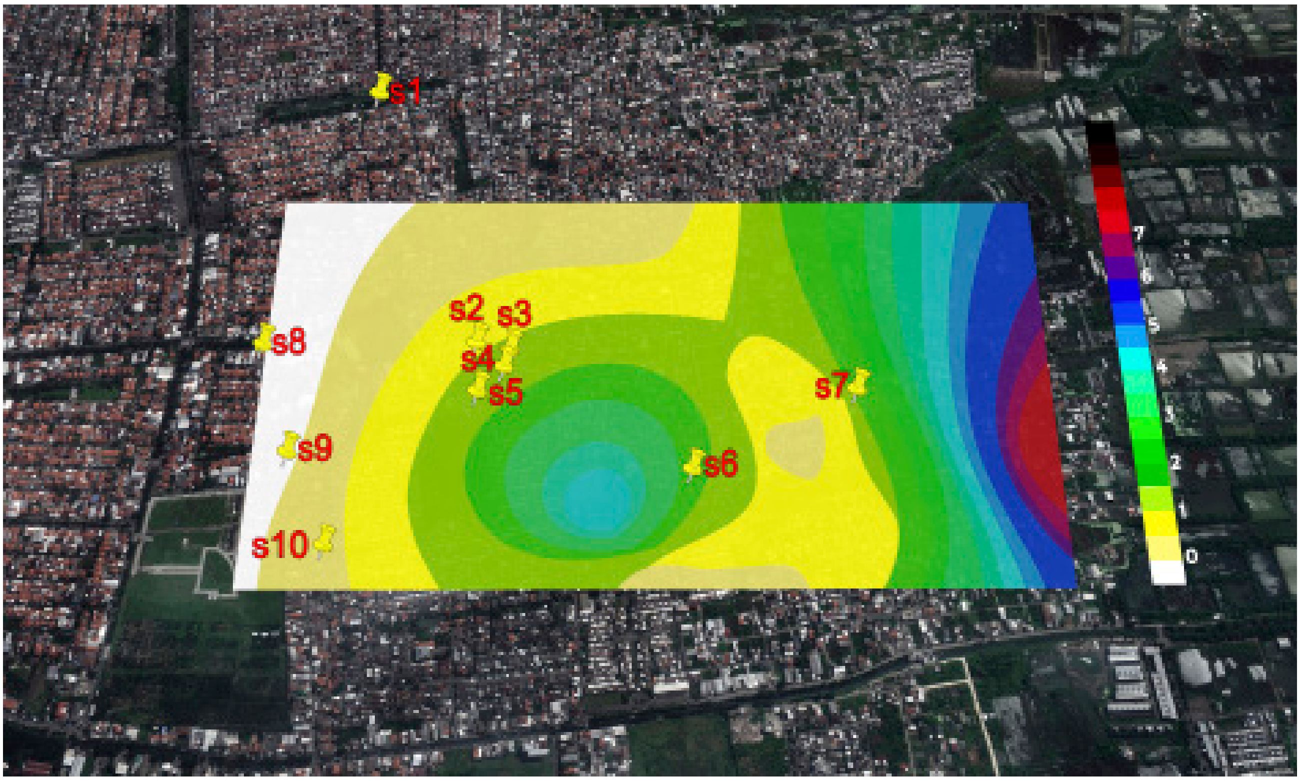

Fig. 2. Distribution of contamination Mn using surfer

-of Manganese in the rock or soil around the well. The danger of consuming water containing Manganese that exceeds the specified threshold in the long term for humans is causing nervous system disorders, can cause impotence in men, muscle weakness, headaches and insomnia. The solution to reducing manganese levels in water is to make a water filter from sand and add zeolite stone before the well water is processed and drunk as a source of clean water (Ghosh et al., 2020),(Schullehner et al., 2020),(Nguyen et al., 2020).

3.3 TSS Analysis of Groundwater Quality

TSS or total suspended solids is suspended material with a diameter of > 1 m which is retained on a 0.45 m pore diameter millipore filter due to evaporation and heating at a temperature of 103-105ºC. The water quality testing results for TSS parameters at each sample location are shown in figure 1. TSS Test Results at Well. TSS Pollution Tests were distributed on all wells in the specified area from wells 1 to 10. The distribution of TSS pollution in well water in the Mendokan Ayu area can be seen in Fig. 3.

Fig. 3 describe that white to green colored on the map meet the quality standards then light Blue color to the colors Black on the map does not meet-quality standards. From the above picture can be seen that there are some wells were experiencing high levels of pollution. Several sample points with high TSS (total suspended solid) pollution or that exceed quality standards are found in wells 1, wells 3, wells 5, wells 6, wells 7, wells 8, wells 9, and wells 10. and we can compare the colors contained in the map, the higher the level of pollution, the color pattern will change where wells that are below the quality standard or meet the quality standard on the map are white while the wells that do not meet the quality standard are light blue to black. Based on the results of Figure 3 it can be seen that the level of TSS pollution for each well sample is very high where the average TSS test results are above the threshold The limits for water quality are Well 1: 1,200 mg/L, Well 3: w1,200 mg/L, Well 5: 800 mg/L, Well 6: 1,600 mg/L, Well 7: 1,600 mg/L, Well 8 : 1,200 mg/L, Well 9 : 1,200 mg/L, and Well 10 : 1,200 mg/L. Based on the water quality criteria of PP No. 82 of 2001, the recommended TSS requirement for water is 400 mg/L. The results of the TSS value in this study are between 400-1600 mg/L, at Well 1,-Well 3, Well 5, Well 6, Well 7 , Well 8, Well 9, and Well 10 and are above Class III and Class IV. The higher the TSS value, the worse the water quality.

Well water in the Medokan Ayu area has a TSS-

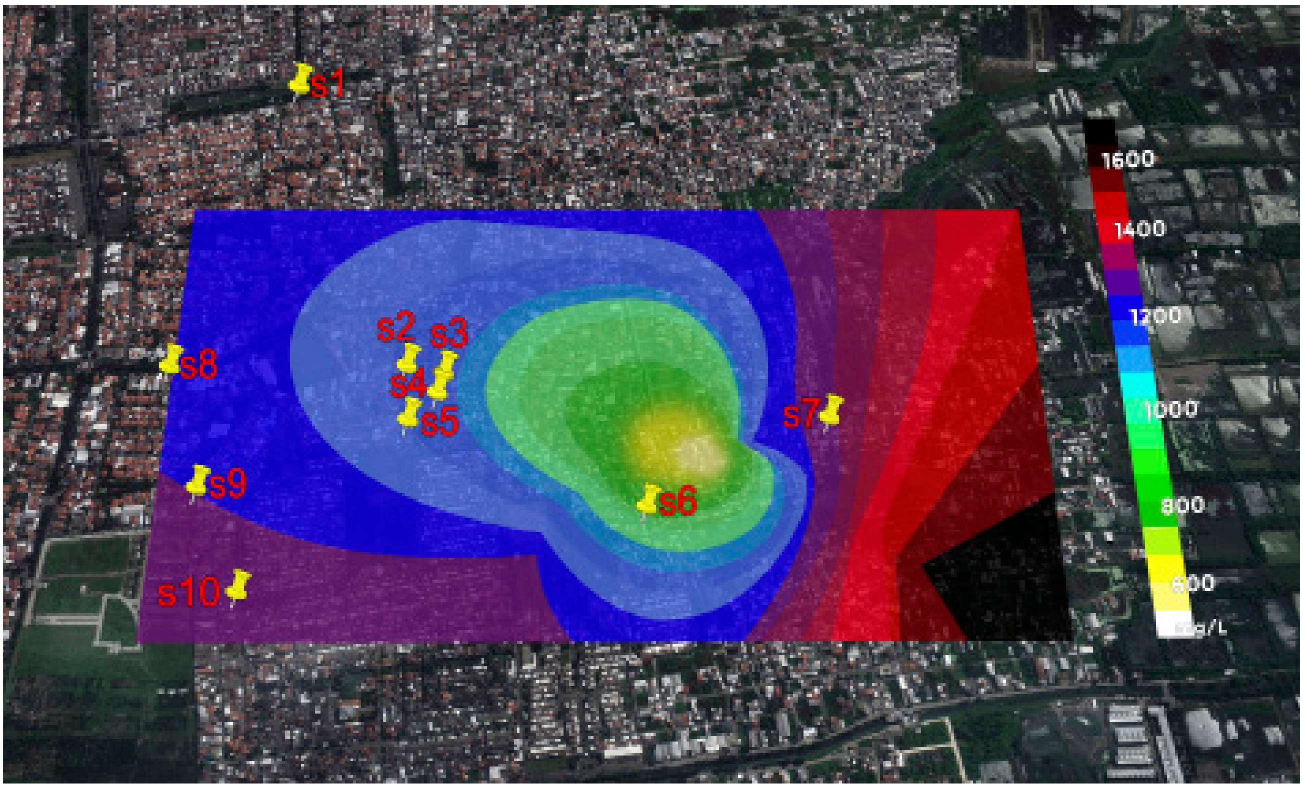

Fig. 3. Distribution of contamination TSS maps using Surfer

-value that is within normal limits in wells number 2 and number 4, which means a little suspended solids. It can be seen from the clearer water conditions compared to other wells in Medokan Ayu. Suspended solids can cause turbidity because they inhibit light penetration. Well water in the Medokan Ayu area has a high TSS value found in 8 wells, namely well 1, well 3, well 5, well 6, well 7, well 8, well 9, and well 10, this can be seen from the cloudy water conditions and also some are yellowish.

The high suspended solids at the Medokan Ayu location can be caused by algae, bacteria or fungi, seepage water from washing and bathing areas, besides that the location is very close to the highway which is often traversed by motorized vehicles. Dust enters the well causing suspended solids to increase. The bottom wall of the well is also filled with moss and algae which can add suspended solids. Suspended solids (Total Suspended Solids) are all solids (sand, mud, and clay) or particles suspended in water. TSS consists of silt and fine sand and micro-organisms, which are mainly caused by soil erosion or soil erosion carried into water bodies. A decay or turbidity reaction occurs if the TSS content exceeds the threshold. In addition, excessive TSS content can affect the number of bacteria content so that the water quality decreases.

Particles carried by the flow of water bodies affect the amount of TSS levels inside. If the Total Suspended Solid (TSS) is high and exceeds the specified quality standard, it will block the entry of sunlight into the water, so that it will interfere with the photosynthesis process causing a decrease in dissolved oxygen released into the water by plants. If sunlight is blocked from the base of the plant, the plant will stop producing oxygen and will die. Total Suspended Solid (TSS) also causes a decrease in water clarity. The concentration of TSS will affect the penetration of sunlight into the waters, so that it will have implications for the photosynthesis process which will ultimately affect the quality and productivity of the waters (Topp et al., 2020), (Nilam Kusuma et al., 2020). TSS is a solid consisting of organic and inorganic compounds soluble in water, minerals and their salts. The high level of TSS in the sample is thought to be influenced by the condition of the well adjacent to the water ditch. The amount of organic content that seeps into the soil as a result of seepage of groundwater flow into the well and the well receives a lot of waste originating from various household wastes from agriculture/forestry, industry, transportation, and so on, resulting in waste that is organic and inorganic compounds. other compounds. Groundwater or surface water close to the coast, the TSS content has a correlation-

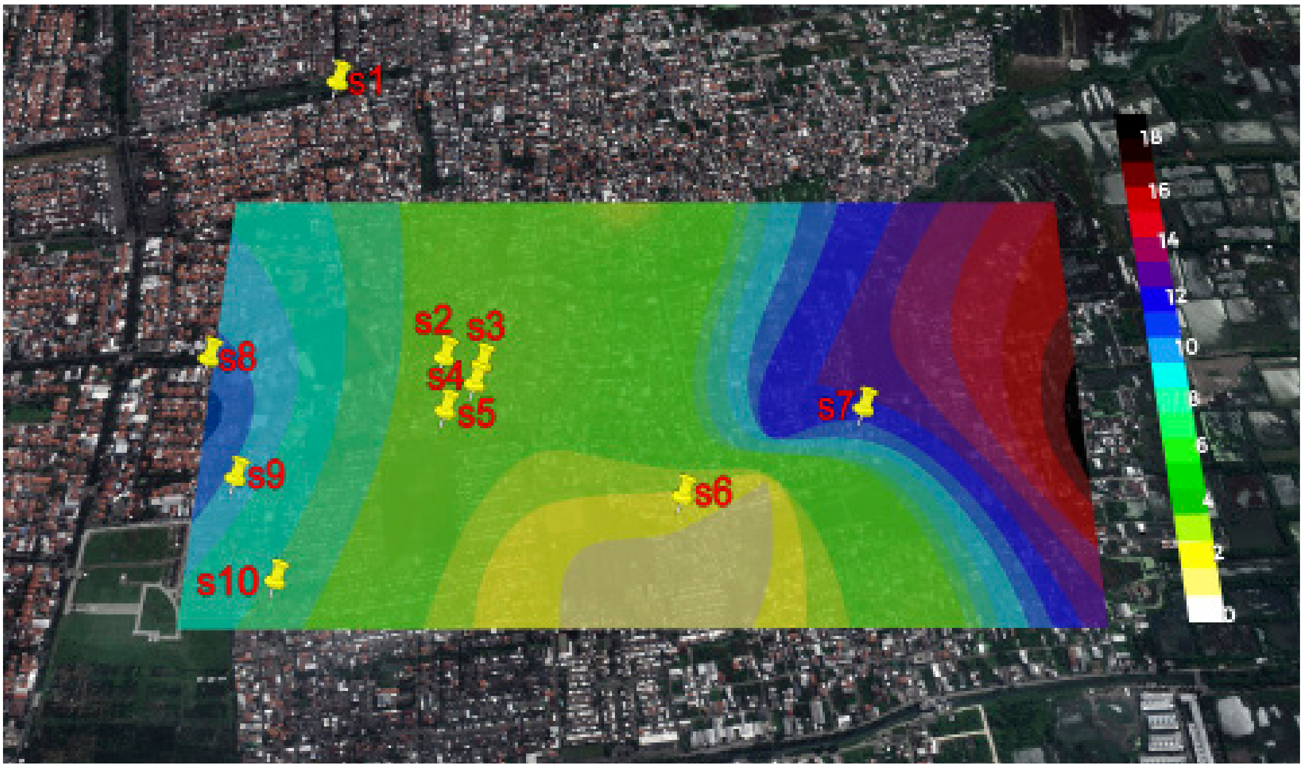

Fig. 4. Turbidity polution distribution maps using Surfer

-with salinity levels or salt (NaCl) concentrations. Water with high TSS content causes scale in household appliances, and water has an unpleasant taste such as a metallic taste (murad, 2021).

3.4 Turbidity Analysis of Groundwater Quality

Turbidity is a clean water problem where its presence in well water that exceeds the quality standard will impact nutrients for bacteria, viruses, and protozoa embedded in water particles (Pichel et al., 2019),(Bodzek et al., 2019). Turbidity will directly picture microbes and interfere with ultraviolet light disinfection methods. The causative factor of turbidity of well water can be seen from the type of well. Where dug wells come from a layer of soil that is relatively close to the ground surface so that they are easily exposed to contamination through seepage from human waste disposal sites and waste from the well (Tangahu et al., 2021),(Bhattacharya et al., 2020)(Kusuma et al., 2018).

Drilled wells are made by drilling deeper groundwater layers to be less affected by contamination (Andriansyah et al., 2020),(Perrone & Jasechko, 2019). Thus the turbidity concentration test will be carried out at each well location determined. For more details, the turbidity value of each sample can be seen in Figure 3 below. Pollution The distribution of Turbidity pollution in wells in the Mendokan Ayu area, Rungkut sub-district, Surabaya City. In this study, there were several wells with quite high turbidity values. The following is a mapping result that can be seen from several sample points that have Turbidity levels ranging from 1.68 - 17.97 NTU and there are no wells that exceed the clean water quality standards. Still, for drinking water quality standards there are about 5 wells that do not suitable if consumed, namely wells number 2, 3, 6, 7 and 8. and we can compare the colors contained in the map, the higher the level of pollution, the color pattern will change where the well is below the quality standard or meets the quality standard on the map The white wells areand yellow. In contrast, the wells that do not meet the quality standard are light green to black.

Fig. 4 describe that white to yellow color on the map meets quality standards then green to black color on map does not meet quality standards. The results of measurements of well water around Medokan Ayu Surabaya show some Most of the water quality parameters studied, namely Manganese,-TSS, exceeded the maximum threshold specified in the Regulation of the Minister of Health Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitary Hygiene, Swimming Pools, Solus Per Aqua, and Public Baths. The quality of dug well water sourced from groundwater carries residues from the soil, and it is important to note that there are sources of pollution that can seep into groundwater (Bhattacharya et al., 2020),(Maritha Nilam Kusuma, Wahyono Hadi, Nur Indradewi Oktavitri, 2020) .

Between 1.68 - 17.97 NTU, no wells exceeded the clean water quality standards based on The threshold according to the Regulation of the Minister of Health Number 32 of 2017. The high results of the groundwater analysis are due to the location of residents' wells and residential areas which are lowlands. While the point that experiences the lowest turbidity value is because the well is far from the pollutant source and the closer it is to the beach, the well's water quality is getting cloudier. Inorganic substances, usually derived from weathered rocks and metals, while organic substances can come from plants and animals. Organic substances can become food for bacteria, so that their addition will increase the turbidity of the water. Likewise, algae that reproduce due to the presence of nutrients N, P, and K will increase water turbidity.Turbid water will be difficult to disinfect, because microbes are protected by these suspended substances (Islam et al., 2021),(Imran et al., 2019). Particular design material will also considering resedential well due to micro organism parameter [20-29].

Another thing that affects the well water around Medokan Ayu Surabaya is influenced by several environmental factors such as the depth of the groundwater table which ranges from 3-6 meters and an elevation of about 2-4 meters. Sources of pollution include algae, bacteria, or fungi around the walls of the well. Also seepage water from washing and bathing areas, besides that the location is very close to the highway which is often passed by motorized vehicles, the environmental conditions are very dusty and the wells are usually not closed so that dust enters the well, and there are many users for each existing well. The mapping results using Surfer software have an average high level of pollution that occurs in well water around Medokan Ayu Surabaya, the most among the three-

-examination results using the TSS, Turbidity and Manganese parameters are well number 6, well number 7, and well number 9. Among the three The value of the wells is as follows:

Table 2. Distribution Pattern of TSS, Mn and Turbidity with Highest Concentration

No. Well	TSS	Manganes	Turbidity
6	1600 mg/L	1.8 mg/L	7.83 NTU
7	1600 mg/L	8.6 mg/L	17.97 NTU
9	1200 mg/L	4.3 mg/L	2.93 NTU

The distribution pattern of TSS, Turbidity and Manganese using Surfer software, the average high level of pollution that occurs in well water around Medokan Ayu Surabaya is the most among the three: well number 6 TSS : 1600 mg/L, Manganese : 1 ,7 mg/L, Turbidity : 7.83 NTU, well number 7 TSS : 1600 mg/L, Manganese : 1.7 mg/L, Turbidity : 17.97 NTU, and well number 9 TSS : 1200 mg/L, Manganese : 1.7 mg/L, Turbidity : 2.93 NTU. according to the distribution pattern of the pollution level in well water around Medokan Ayu Surabaya. 3 wells have the highest concentration. According to the practice of distribution, the high levels of Manganese, TSS, and Turbidity in wells number 7 and 9 come from household waste such as washing water that is absorbed into the ground. While in well number 6 the high Manganese, TSS, and turbidity are due to vehicle activities and water waste generated by household activities. This can be seen in the TSS distribution pattern on the surfer map which shows well 6 which is dark red in color, while the Mn parameter in well 6 shows a light green color, and the turbineity parameter of well number 6 shows a bluish green color.

Then in well 7 for the distribution of TSS contamination on the Surfer map, well 7 shows a blackish red color or can be said to be very high in pollution. In contrast, for the Mn parameter on the surfer map well number 7 shows a dark red color and for the turbidity parameter in well number 7 shows a blackish red color in well number 9 the distribution of TSS contamination is blue. In contrast, for the Mn parameter on the surfer map well number 9 shows a light blue color and for-the turbidity parameter in well number 9 shows yellow.

According to the Ministry of Health of the Republic of Indonesia (1990, p.19), the health requirements that must be met by well facilities, especially regarding the distance of the well, are the distance of the well at least 11m from sources of pollution such as latrines, dirty water or sewers, landfills, cattle pens and livestock manure. Based on the measurement of the distance between the pollutant source and the well, with 10 samples taken at medokan ayu, there are 5 sources of pollution, including latrines, dirty water or sewers, landfills, vehicle pollution, infiltration channels. And the five pollutant sources are categorized as not fulfilling the requirements, namely 100%. Well construction must comply with health standards. The physical structure of the well that does not meet the standards will make it easier for bacteria to seep and enter the well. Dug well construction requirements are as follows: The walls must be watertight wells as deep as 3 m from the ground surface to prevent seepage from surface water, wells must be watertight lips as high as 0.5-0.7 m from ground level or flood boundary line, to prevent seepage of used water into the well, the wall of the dug well with the installation of bricks or stone is made by installing bare stones starting from the bottom of the well to the waterproof wall above it, namely at a depth of 3 m below the ground surface, to drain groundwater into the well, the floor of the well made watertight, the distance from the edge of the floor to the outer edge of the well is 1 m, the floor thickness is at least 0.20 m from the ground, and the shape of the floor of the well is square or circular.

4. Conclusion

There is no meaningful relationship between the well depth and the manganese content in the water, in addition, as many as 7 well samples exceed the predetermined quality standards. There is no relationship or correlation between the well depth and the TSS content. The entire TSS content in 10 samples exceeds the specified quality standard limit. Those show that it is possible from the fall in the soil when the flows is high, so the soil is carried away by the flow of the water, so that it cause solid particle sedimentation. Turbidity has a negative relationship with the depth of the well. The means-

-that the deeper of the well depth, so that the smaller the value of the turbidity of the water. The turbidity value of well sample 4 is below the maximum limit of the allowed quality standard, while the other sample is above the quality standard. Turbidity has a correlation with TSS, so the higher solids value of the particle, the higher the turbidity of value too.

Reference

Adawiah, S. W., Setiawan, K. T., Parwati, E., & Faristyawan, R. (2021). Development of Empirical Model of Total Suspended Solid (TSS) by using Landsat 8 on the Coast of Bekasi Regency. IOP Conference Series: Earth and Environmental Science, 750(1). https://doi.org/10.1088/1755-1315/750/1/012039

Andriansyah, I., Razif, M., Maritha, A., & Kusuma, N. (2020). Lake Water Treatment Of Padengan Ploso Village, Lamongan District With Filtration And Adsorption Process. Poll Res, 39(1), 59–63.

Bhattacharya, M., Shriwastav, A., Bhole, S., Silori, R., Mansfeldt, T., Kretzschmar, R., & Singh, A. (2020). Processes Governing Chromium Contamination of Groundwater and Soil from a Chromium Waste Source. ACS Earth and Space Chemistry, 4(1), 35–49. https://doi.org/10.1021/acsearthspacechem.9b00223

Bodzek, M., Konieczny, K., & Rajca, M. (2019). Membranes in water and wastewater disinfection – review. In Archives of Environmental Protection (Vol. 45, Issue 1, pp. 3–18). Polish Academy of Sciences. https://doi.org/10.24425/aep.2019.126419

Burri, N. M., Weatherl, R., Moeck, C., & Schirmer, M. (2019). A review of threats to groundwater quality in the anthropocene. In Science of the Total Environment (Vol. 684, pp. 136–154). Elsevier B.V. https://doi.org/10.1016/j.scitotenv.2019.05.236

Ghosh, G. C., Khan, M. J. H., Chakraborty, T. K., Zaman, S., Kabir, A. H. M. E., & Tanaka, H. (2020). Human health risk assessment of elevated and--variable iron and manganese intake with arsenic-safe groundwater in Jashore, Bangladesh. Scientific Reports, 10(1). https://doi.org/10.1038/s41598-020-62187-5

Hajar, I., Zamhari, M., & Yuliati, S. (2021). Tofu Industrial Wastewater Treatment by Electrocoagulation Method.

Hardiana, T. O., Hidayati, R. N., Anggoro, W., & Irawati, N. (2019, April). Detection of water turbidity using LDR sensor. In Third International Seminar on Photonics, Optics, and Its Applications (ISPhOA 2018) (Vol. 11044, pp. 66-69). SPIE. https://doi.org/10.1117/12.2504923

Imran, M., Das, K. R., & Naik, M. M. (2019). Co-selection of multi-antibiotic resistance in bacterial pathogens in metal and microplastic contaminated environments: An emerging health threat. In Chemosphere (Vol. 215, pp. 846–857). Elsevier Ltd. https://doi.org/10.1016/j.chemosphere.2018.10.114

Islam, M. M. M., Iqbal, M. S., D'Souza, N., & Islam, M. A. (2021). A review on present and future microbial surface water quality worldwide. In Environmental Nanotechnology, Monitoring and Management (Vol. 16). Elsevier B.V. https://doi.org/10.1016/j.enmm.2021.100523

Kusuma, M. N., Hadi, W., & Wirjodirdjo, B. (2018). Preliminary study of infiltration gallery for water treatment towards universal access 2019 in Indonesia. Soil and Environment, 37(1), 83–88. https://doi.org/10.25252/SE/18/51284

Maritha Nilam Kusuma, Wahyono Hadi, Nur Indradewi Oktavitri, T. P. (2020). Upflow Roughing Filter In Series As Alternative Pretreatment In Water Treatment Plant Siwalanpanji, Sidoarjo, Indonesia. Article-25 Poll Res, 39(4), 181–187.

murad, dzaky. (2021). Using Check-If-Apply Lists to Improve Communication About Aesthetic Water Issues.

Mustafa, S., Bhatti, H. N., Maqbool, M., & Iqbal, M. (2021). Microalgae biosorption, bioaccumulation and biodegradation efficiency for the remediation of wastewater and carbon dioxide mitigation: Prospects, challenges and opportunities. Journal of Water Process Engineering, 41, 102009. https://doi.org/10.1016/j.jwpe.2021.102009

Nguyen, T. T. Q., Loganathan, P., Nguyen, T. V., & Vigneswaran, S. (2020). Removing arsenic from water with an original and modified natural manganese oxide ore: batch kinetic and--equilibrium adsorption studies. Environmental Science and Pollution Research, 27(5), 5490–5502. https://doi.org/10.1007/s11356-019-07284-3

Nilam Kusuma, M., Wirjodirjo, B., Hadi, W., & Fitriani, N. (2020). Scenarios Modification Of Hydraulic Conductivity To Time Period Of Clogging In Infiltration Gallery. Article-31 Poll Res, 39(4), 221–224.

Parwati, E., & Purwanto, A. D. (2017). Time Series Analysis of Total Suspended Solid (Tss) Using Landsat Data in Berau Coastal Area, Indonesia. International Journal of Remote Sensing and Earth Sciences (IJReSES), 14(1), 61. https://doi.

org/10.30536/j.ijreses.2017.v14.a2676
Perrone, D., & Jasechko, S. (2019). Deeper well drilling an unsustainable stopgap to groundwater depletion. Nature Sustainability, 2(8), 773–782. https://doi.org/10.1038/s41893-019-0325-z
Pichel, N., Vivar, M., & Fuentes, M. (2019). The problem of drinking water access: A review of disinfection technologies with an emphasis on solar treatment methods. In Chemosphere (Vol. 218, pp. 1014–1030). Elsevier Ltd. https://doi.org/10.1016/j.chemosphere.2018.11.205
Qin, X., Zhang, H., Wang, Z., & Jin, Y. (2019). Fe3O4@SiO2 mesoporous spheres as Fe(ii) donors loaded with artemisinin and a photosensitizer to alleviate tumor hypoxia in PDT for enhanced anticancer therapy. New Journal of Chemistry, 43(22), 8761–8773. https://doi.org/10.1039/c9nj00974d
Schullehner, J., Thygesen, M., Kristiansen, S. M., Hansen, B., Pedersen, C. B., & Dalsgaard, S. (2020). Exposure to manganese in drinking water during childhood and association with attention-deficit hyperactivity disorder: A nationwide cohort study. Environmental Health Perspectives, 128(9), 1–10. https://doi.org/10.1289/EHP6391
Seleiman, M. F., Santanen, A., & Mäkelä, P. S. A. (2020). Recycling sludge on cropland as fertilizer – Advantages and risks. In- Resources, Conservation and Recycling (Vol. 155). Elsevier B.V. https://doi.org/10.1016/j.resconrec.2019.104647.
Somura, H., Yuwono, S. B., Ismono, H., Arifin, B., Fitriani, F., & Kada, R. (2019). Relationship between water quality variations and land use in the Batutegi Dam Watershed, Sekampung, Indonesia. Lakes and Reservoirs: Research and Management, 24(1), 93–101. https://doi.org/10.1111/lre.12221
Sutadian, A. D., Muttil, N., Yilmaz, A. G., & Perera, B. J. C. (2018). Development of a water quality index for--rivers in West Java Province, Indonesia. Ecological Indicators, 85(December 2017), 966–982. https://doi.org/10.1016/j.ecolind.2017.11.049
Tangahu, B. V., Gde Kartika, A. A., Sambodho, K., Putri Marendra, S. M., & Arliyani, I. (2021). Shallow Groundwater Pollution Index Around the Location of Griyo Mulyo Landfill (Jabon Landfill) in Jabon District, Sidoarjo Regency, East Java, Indonesia. Journal of Ecological Engineering, 222(3), 199–210. https://doi.org/10.12911/22998993/132658
Topp, S. N., Pavelsky, T. M., Jensen, D., Simard, M., & Ross, M. R. V. (2020). Research trends in the use of remote sensing for inland water quality science: Moving towards multidisciplinary applications. In Water (Switzerland) (Vol. 12, Issue 1). MDPI AG. https://doi.org/10.3390/w12010169.