Proceedings of the 8th World Congress on Civil, Structural, and Environmental Engineering (CSEE'23)
Lisbon, Portugal – March 29 – 31, 2023
Paper No. ICEPTP 125
DOI: 10.11159/iceptp23.125

Environmental Risk of Turbidity Caused by Construction Activities near the Gulf in UAE

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Abstract **-** Studies indicate that construction activities can affect several water surfaces; hence, the Environmental Protection Agency (EPA) has examined the environmental impacts of construction sites near water surfaces. However, whilst much attention has been given to environmental risks to streams and small rivers, there has been limited exploration of the risk to large bodies of surface water, especially in the Gulf. This research paper helps to address this shortcoming by focusing on turbidity caused by construction activities in two construction sites located twelve meters from the Gulf in Abu Dhabi City (the capital) in the United Arab Emirates (UAE) and at a 500m distance from each other. This distance is hypothesized as the safest distance for occupied buildings and recreation. The objective of the study is to monitor the environmental risk of turbidity near construction-booming areas and its impact on the nearby occupied residential area and recreation; and additionally, to assess the effect of temperature on turbidity levels at different times during the day. The first site was undergoing construction at varying levels ranging from excavation to structural framing and infrastructure activities. The second site was completed and occupied. Turbidity was monitored twice a week over a period of four weeks. Thirty-two water samples were tested during the peak time of construction activities, and after six hours (no activities), taking into consideration the weather conditions. The results indicate that maximum turbidity levels were noticed when the temperature was between 42°C and 44°C. This indication of turbidity during this time of the year may not be safe for any recreation adjacent to construction activities, especially since temperature increases the risks of the turbidity effect. Consequently, continuous monitoring is important.

Keywords**:** Environmental risk, turbidity, construction activities, water quality.

1. Introduction

Construction activities near water surfaces are leading to variations in the environment because of turbidity. A wide range of ecosystems can be affected, especially by the changes in temperature and the wind that reaches more than 30 miles per hour and causes massive sandstorms in the Desert. Therefore, ongoing awareness research is crucial to minimize the impact of construction-related turbidity [1]. Technologies of turbidity reduction are crucial [2] to consistently achieve safety for urban areas during the construction boom. In most instances, run-off is a problem during rain time, as it increases drainage from construction sites to the water surface [3], and it enhances the potential for difficulties associated with soil erosion control.

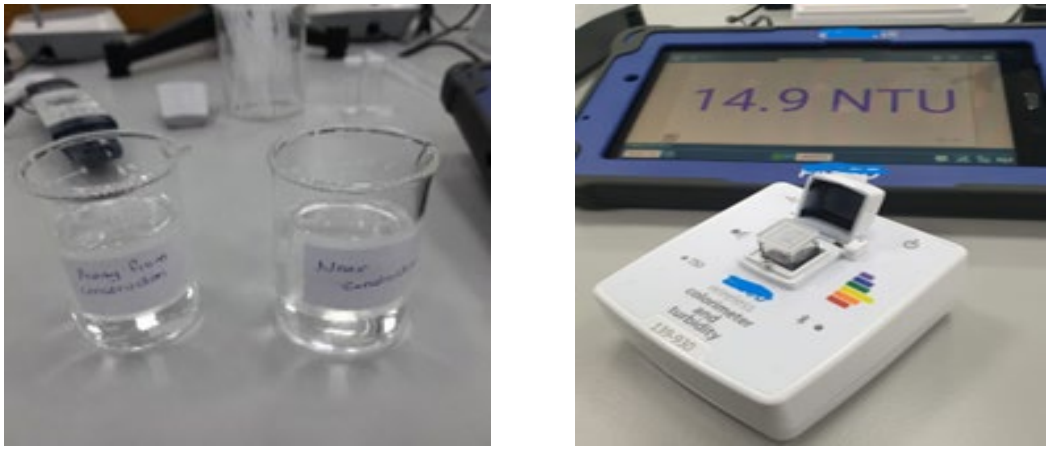
In British Columbia, the Environmental Protection Agency (EPA) has documented turbidity of 500 NTU 300 feet downstream of a construction site that resulted from a high sedimentation level and flushed in two years [4]. A combination of the impact on the water surface from the golf course and residential construction was observed 10 miles downstream [4]. However, the Clean Water Act has reported the quality of surface water to EPA every two years whatever the purpose of use, drinking, navigation, recreation, etc. Since turbidity discharge is much higher than would be observed naturally. More importantly, historic contaminations caused by pollutants run-off have been carried to water surfaces in a solution that is derived from construction materials and equipment on construction sites. More data on turbidity is beneficial to verify the maximum allowed concentration [5]. Simultaneously, weather conditions should be considered, for example, turbidity was highly correlated with the quantity of wind received preceding [6] and seen to increase temperature dynamics [7].

The baseline of the current study was specifically concerned with turbidity variations associated with construction sites close to the Gulf and located in Abu Dhabi City, UAE. Public awareness of the inclusion of coastal construction developments within the issue of environmental risk has been increased by the combination of human activities in this area, and hence this is an important topic for study. Specifically, the aim of the study is to characterize the safety of water surfaces from turbidity near the developing and booming residential and recreational areas in Abu Dhabi City and to assess the variability according to temperature only during the hot season (peak summer). The weather conditions are particularly taken into account to predict future levels of turbidity in such areas and seasons. In this connection, the temperature is used as the main forecast factor

2. Methods

The targeted location which is about 12m from the water surface in the Gulf of the UAE, was chosen due to the active construction activities. The location is considered as a developing residential area where some water activities such as fishing, sailing, and swimming are in evidence. Water samples were collected from two main locations, close to each other and both experiencing a similar climate. The first location was adjacent to an active construction site and the second was 500m away from that. Samples were collected over two periods of the day. For each location, one sample was collected during the afternoon when construction activities were active, and another was collected in the evening after the end of the day's construction work. This pattern resulted in a total of 32 water samples from a depth of one meter obtained over the months of May and June. Weather conditions were recorded for each reading taken, including wind speed, temperature, precipitation, and humidity. As per Environmental Protection Agency (EPA) standards, samples were tested within 24 hours from the time of collection. Turbidity was hypothesized to happen due to suspended particles; hence, sedimentation can contribute to the values of turbidity. Therefore, before testing, samples were shaken properly to ensure that no sedimentation process affected the results. Samples from the different construction locations are shown in Fig. (1-a).

A turbidimeter, Fig. (1-b), was used to measure the turbidity of samples. The meter measures scattered light at a 90-degree angle from the sample. Water samples were placed in cuvettes for testing. Given the dense internal housing of the cuvettes, the ambient light interference was limited and thus accuracy was preserved.



(a) (b)

Fig. 1. Experimental testing (a) water samples, (b) Turbidimeter

3. Results and Discussion

Turbidity values were observed over a period of one month, from the end of May until the end of June. During this time time of the year in the UAE, the weather starts to get hotter and humidity levels increase. A noticeable variation in humidity humidity levels, temperature, and wind speed was observed throughout the testing period. The contour plot in Fig. 2 shows shows Location 1 as the construction site, and Location 2 at a point 500m away from the construction site. Turbidity levels levels were much higher in the water next to the construction site (Location 1) compared to water away from the construction site (Location 2). Generally, the turbidity of water away from the construction site was less than 15 nephelometric turbidity units (NTU), except when the temperature reached its maximum value of 46°C when the turbidity of water away from the construction site reached its maximum value of 15.9 NTU. Most of the samples showed turbidity of 0 NTU at the location away from the construction. However, some samples were collected during the construction activity, and some when the construction activity was over for the day. Construction activity reaches its peak just before noon and ends daily around 18:00 hours. Turbidity levels of water away from the construction activity were generally low and, in most samples, equal to zero, but as shown in the contour plot in Figure 3, a slight increase was observed between 13:30 and 14:30 hours, which is immediately after the peak of construction activities at the site. Similarly, turbidity levels of water at the construction site also reached the maximum level during the same time interval.

Noticeably, turbidity levels at the construction site were higher and increased over time. For samples collected in May, these levels were lower compared to samples collected in June, likely because of the increase in temperature and humidity levels in June. The maximum turbidity level was found to be 27 NTU. Considering the effect of location and temperature simultaneously as indicated in the contour plot in Figure 3, in Location 2 which is away from the construction activity, for almost all the collected samples, turbidity was not affected by the temperature increase until the temperature reached its maximum level which was 46°C. However, the turbidity of water at the construction site (Location 1) was affected by temperature. Maximum turbidity levels were noticed when the temperature was between 42°C and 44°C.

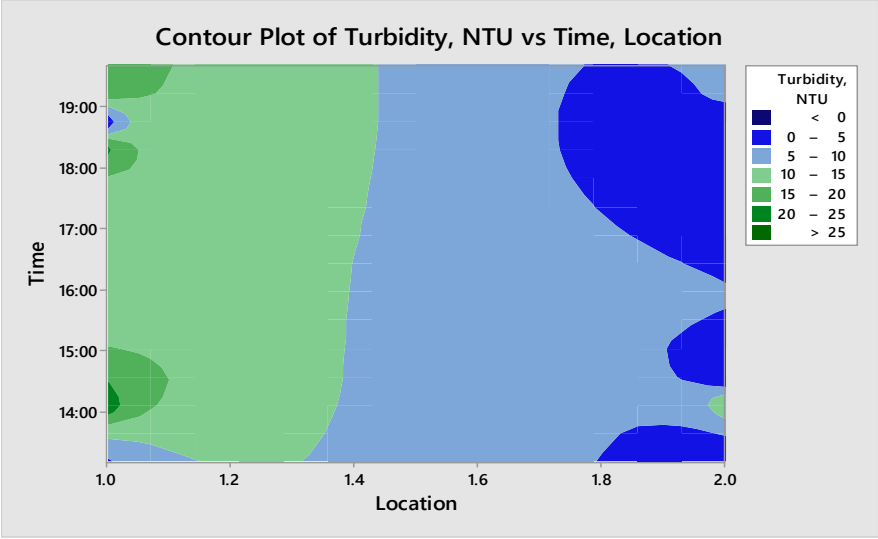


Fig. 2: Contour plot of turbidity, time, and locations (1)&(2)

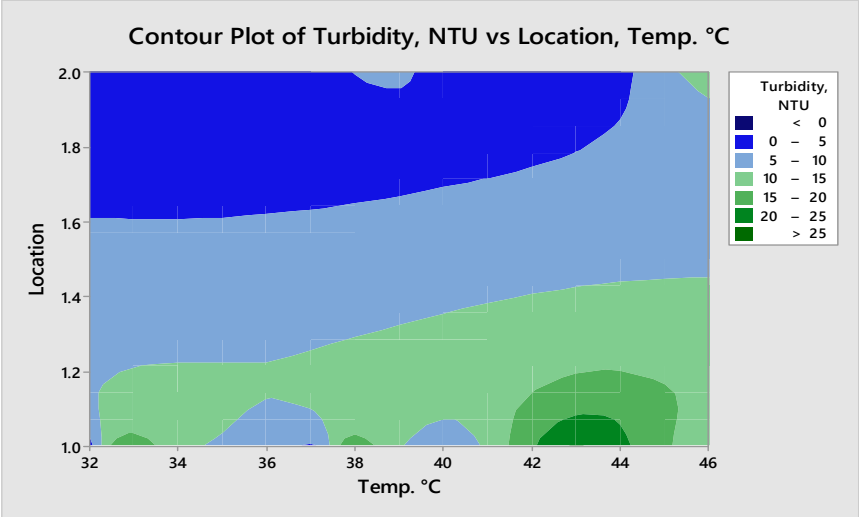


Fig. 3: Contour plot of turbidity vs. location and temperature

4. Conclusion

Turbidity changes were measured in construction locations near the Gulf, UAE. As part of EPA regulations, water samples were tested in an environmental lab within 24 hours of collection, and weather conditions during the hot summer were noted. The highest turbidity occurred in the active construction location during peak time and temperatures were between 42°C and 44°C. Interpretation of resuspension construction materials caused sediments and is most probably a major cause of turbidity in the water surface of the Gulf. Turbidity was highly correlated with the quantity of temperature and wind received for the two locations preceding the sampling, but the research paper has a limited relationship between turbidity and temperature and had the highest level of turbidity significance during the summer. In addition, 500m from construction activities is projected to be safe for the residential area since recreation, swimming, and fishing or aqua life are noticed to be active and since turbidity levels of water are generally low. However, this magnitude of turbidity resulting from construction activities adjacent to the water surface should be monitored continually. Turbidity may decrease the quality of life nearby the water surface over time.

More research will be performed considering more testing for TDS, pH, and conductivity and more seasonal data collection.

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