Water quality assessment of lake uhe lajeado in the municipality of Porto Nacional/TO

Water, fundamental for the maintenance of life, is a resource that goes through a constant crisis, especially regarding scarcity, mainly due to the increase in consumption and the uncontrolled pollution of water bodies. In addition to obtaining qualitative and quantitative information on water resources, the monitoring has the purpose of obtaining biological, chemical, physical and ecological information, as well as class classification. The sources of pollution in hydrographic basins are numerous, in this study the main focus found is urban pollution, which generates pollution mainly through the release of sanitary sewage 'in natura' and various solids, becoming sources of contamination quite aggravating when in the absence of riparian forests. In the present study, an analysis was carried out in which water quality was monitored at a point on Lake UHE Lajeado in the municipality of Porto Nacional - TO, its importance is due to the fact that the site serves as a new point of water capture for urban supply, it soon hopes to define whether the water body complies with the water quality standards - IQA NSF. Water quality was assessed by permissible limits established by CONAMA Resolution nº 357/2005 and NSF - National Sanitation Fundation, which was evaluated on 9 parameters that made it possible to calculate the IQA - Water Quality Index.

Keywords: Water resource; Hydrographic basin; Water Quality Index.

Avaliação da qualidade da água do lago uhe lajeado no município de Porto Nacional/TO

A água, fundamental para a manutenção da vida, é um recurso que passa por constante crise, sobretudo, quanto à escassez, fruto principalmente da ampliação do consumo e da poluição desenfreada dos corpos hídricos. Além de obter informações qualitativas e quantitativas sobre a qualidade do recurso hídrico, o monitoramento tem o propósito de obter informações biológicas, químicas, físicas e ecológicas, bem como, o enquadramento em classe. As fontes de poluição de bacias hidrográficas são inúmeras, nesse estudo o foco principal constatado é a poluição urbana, que gera poluição principalmente através do lançamento de esgoto sanitário ‘in natura’ e sólidos diversos, se tornando fontes de contaminação bastante agravante quando na ausência de matas ciliares. No presente estudo foi realizada uma análise em que foi feito um acompanhamento da qualidade da água, em um ponto do Lago UHE Lajeado no município de Porto Nacional/TO, sua importância se deve ao fato do local servir como um novo ponto de captação de água para o abastecimento urbano, logo espera definir se o corpo hídrico contempla os padrões de qualidade da água – IQA NSF. A qualidade da água foi avaliada por limites permissíveis estabelecidos pela resolução CONAMA nº357/2005 e NSF – National Sanitation Fundation, que foi avaliado em 9 parâmetros que possibilitaram o cálculo do IQA – Índice de Qualidade da Água.

Palavras-chave: Recurso hídrico; Bacia Hidrográfica; Índice de Qualidade da Água.
INTRODUCTION

Essential to life, water is a necessary element for practically all human activities, and is also a component of the landscape and the environment. As a fundamental resource, it must be conserved and protected. Its purpose is suitable for multiple uses, whether for domestic and industrial supply, electricity generation, irrigation of agricultural crops, recreation, navigation, fishing, aquaculture, fish farming and also for assimilation and removal of sewage (SETTI et al., 2001).

Over the past million years the total amount of water on Earth has remained virtually constant. However, the volume contained in each of the major water reserves on Earth may have varied during that time, at levels never imagined (REBOUÇAS, 2004). Environmental management and nature preservation are the words most spoken today when it comes to the great problem of drinking water, which continues to decrease year after year. Teaching humanity to look back and learn from the example of their own mistakes, has become one of the biggest challenges to avoid the problem of scarcity of drinking water in the near future (DETONI et al., 2008).

Tucci (2009) states that, “in the last century, the total demand for water has increased six times, while the population has grown only three times”. The potable water is vital importance for the survival of living organisms and also to keep ecosystems, communities and economies in perfect working order. However, population growth has put the quality of the world’s water resources in risk, as industrial and agricultural activities are also increasing. The water low quality threatens human and ecosystem health, in addition to reducing the availability of potable water and viable water resources for other purposes, limits economic productivity and decreases development opportunities (ANA, 2013).

The lack of management in urban expansion, followed by the partial knowledge of managers about the use of urban rivers for cities, are factors that cause these water bodies to have unhealthy conditions and nature that are opposed to their ecological functions (ROSSI et al., 2012). The water crisis is mainly about distribution, knowledge and resources, and not about absolute scarcity. Thus, most decisions regarding water resources involve problems of access and deprivation (SELBORNE, 2001).

The IQA was created in the 70s, after its creation in the United States by the National Sanitation Foundation - NSF and 5 years later CETESB - Companhia Ambiental do Estado de São Paulo started to use it. Over the decades, other Brazilian states have adopted the IQA, which today is the main water quality index used in the country (ANA, 2020).

In this context, the present study aimed to determine the hydrographic basin conditions through the Water Quality Index (IQA-NSF), analyzing nine parameters (Temperature, Biochemical Oxygen Demand, Hydrogenionic Potential, Dissolved Oxygen, Total Phosphorus, Solids Total Dissolved, Total Nitrogen, Turbidity and Faecal Coliforms) at a point on the Lajeado UHE Lake, in the municipality of Porto Nacional, State of Tocantins, which serves as a new point of capitation of water for urban supply. Having occurred from the months of August 2019 to May 2020, checking if the waters meet the standards determined by Resolutions 357/2005 of the National Environment Council (CONAMA).
METHODOLOGY

The present work consists of an experimental study of a point on the lake, providing assistance in the diagnosis of the current situation and carrying out the analysis of the water through physical-chemical and microbiological exams, in the UHE Lajeado Lake in the Porto Nacional municipality, according to the parameters the National Sanitation Foundation and Standard Methods (APHA, 2005).

Study area

The studied point is located in the hydrographic basin of the Tocantins River on the right bank of Lake UHE Lajeado in the condominium Lake Side Club Residence, sector Alto da Colina, of the municipality Porto Nacional, between the parallels 10° 44'10" and 10° 44'14" South latitude and between the meridians 48° 24'33" and 48° 24'49" west longitude. Figure 1 shows the location of the condominium.

Field methodology

The method used in the field for sample collection was carried out following NBR 9897 (sampling planning for liquid effluents and receiving bodies) and NBR 9898 (preservation and sampling techniques for liquid effluents and receiving bodies), where the collection of samples from water for analysis took place during the six-week period of March and April 2020, using 100ml containers for microbiological and 2000ml for physical-chemical containers, right after collection, the samples were labeled and packed in thermal boxes containing ice, to be processed in the laboratory of IFTO - Federal Institute of Education, Science and Technology of Tocantins, in Porto Nacional and LAPEQ - Laboratory of Research in Chemistry, Federal University of Tocantins (UFT) - Campus Palmas - TO. The collection and preservation of the samples were made using appropriate techniques, without the results being reflected in the conditions at the time the collection was performed. All care was taken with the storage, maintenance and transportation of the collection material. In total for the point under analysis, 6 water samples were collected (microbiological and physical-chemical).
Laboratory methodology

Through the determination of the water quality index, IQA NSF, the monitored water quality attributes used for calculating and adapting the index were: the temperature analyzed through on-site measurement; Biochemical Oxygen Demand (DBO) determined by standard method A; Hydrogenionic potential (pH) determined through direct measurement; Dissolved Oxygen (OD) analyzed with on-site measurement; Total phosphorus determined using the ascorbic acid method after digestion with ammonium persulfate; Total Dissolved Solids (SDT) analyzed using the porcelain capsule method; Total Nitrogen analysis made by the micro Kjeldahl method; Turbidity determined by direct measurement; Fecal Coliforms (CF) using the Colilert technique. As shown in table 1, which presents the parameters and techniques used.

Table 1: Parameters and techniques used.

| PARAMETERS                      | UNITY     | TECHNIQUE USED               |
|---------------------------------|-----------|------------------------------|
| Temperature                     | °C        | Measurement in Loco         |
| Biochemical Oxygen Demand (DBO) | mg/L      | APHA (2005), Differentiation |
| Hydrogenionic Potential (pH)   | Scale     | APHA (2005), Direct Measure |
| Dissolved Oxygen (OD)           | % Saturation | Measurement in Loco |
| Total Phosphorus                | mg/L      | APHA (2005), Spectrophotometry |
| Total Dissolved Solids (SDT)    | mg/L      | APHA (2005), Spectrophotometry |
| Total Nitrogen                  | mg/L      | APHA (2005), Spectrophotometry |
| Turbidity                       | NTU       | APHA (2005), Direct Measure |
| Fecal Coliforms (CF)            | NMP/ 100 mL | APHA (2005), Colilert       |

Water Quality Index NSF

According to Heller et al. (2010), the IQA was calculated by the weighted product of the water qualities corresponding to the parameters, according to the following formula:

$$IQA = \prod_{i=1}^{n} q_i^{wi}$$  
Equation 1:

Where:
- IQA - Water Quality Index (ranges from 0 to 100);
- qi - quality of the i-th parameter, a number between 0 and 100, obtained from the respective average curve of specific quality variation for each parameter, depending on its concentration or measurement;
- wi: weight corresponding to the i-th parameter or sub-level, a number between 0 and 1 (Table 2), assigned according to its importance for the overall quality conformation, being that:
- n - number of parameters (n = 9)

The number ‘n’ will always be equal to nine, since, in the absence of any measure of the parameters that form the IQA, its calculation is not feasible.

$$\sum_{i=1}^{n} Wi = 1$$  
Equation 2:

Where:
- n: number of parameters that enter the AQI calculation.

The calculation of the IQA is not feasible if the value of any of the nine variables is not available. From the calculation performed, it is possible to determine the quality of raw water, which is indicated by the IQA, varying on a scale from 0 to 100, according to Table 2. The category evaluated through the physical-chemical and microbiological parameters of water quality was established according to the weighting values, where
the result falls into a category, which can be from excellent to very bad. The comparison was made with the indexes of standards acceptable by the legislation and technical literature of Resolution 357/05 of CONAMA (National Council of the Environment).

### Table 2: Water quality classification or level as a result of iqa-nsf results

| QUALITY LEVEL | BAND            |
|--------------|-----------------|
| GREAT        | 90 < IQA ≤ 100  |
| GOOD         | 70 < IQA ≤ 90   |
| MEDIUM       | 50 < IQA ≤ 70   |
| BAD          | 25 < IQA ≤ 50   |
| TOO BAD      | IQA ≤ 25        |

Source: Yisa et al. (2012).

### RESULTS AND DISCUSSION

The monitoring of water quality was carried out in the months of February and March 2020, the collection of samples occurred during the rainy and dry season. In the rainy season the water had a dark coloration that comes from the solids carried to the riverbed. In the dry season, the water showed a transparent color. It is important to highlight that the darker color of the water does not indicate contamination, since the colorless water may also be contaminated.

#### IQA NSF water quality parameters

The use of the term water quality is made subjectively, since it is not referring to the purity of the water, but to the physical, chemical and biological characteristics. In this context of IQA evaluation, nine evaluation parameters were selected for the present study, namely: Water Temperature, Dissolved Oxygen (OD), Biochemical Oxygen Demand (DBO), Hydrogenionic Potential (pH), Turbidity, Electric Water Conductivity (CE), Total Dissolved Solids (SDT), Total Nitrogen, Total Phosphorus and Fecal Coliforms (CF) (ANA, 2020).

CONAMA (2005) established a water classification according to Resolution 357/2005, which says that freshwater can be classified into four classes and a special one, and the present study was found to be class 2 water, not what water can be used: supply of human consumption, conventional treatment, protection of aquatic communities, recreation of primary contact, such as swimming, water skiing and diving, according to CONAMA Resolution No. 274 (CONAMA, 2010), irrigation of vegetables, fruit plants and parks, gardens, sports and leisure fields, with 23 which the public may come into direct contact with, and agriculture and fishing.

#### Temperature

Between February and March at the studied point, an average temperature of 24.91°C was recorded, the highest value was recorded in the second collection in February and in the last collection in March, having been 25.1°C, while the lower was in the first collection of February, having registered a value of 24.8°C, considering the rainy period the values varied little. Table 3 shows the average temperature values. Figure 2 presents a graph of the Temperature values.
Table 3: Average water temperature.

| TEMPERATURE | SCORE |
|-------------|-------|
| Feb/20      | 24.8 °C |
| Feb/20      | 25.1 °C |
| Mar/20      | 24.7 °C |
| Mar/20      | 24.9 °C |
| Mar/20      | 24.9 °C |
| Mar/20      | 25.1 °C |
| AVERAGE:    | 24.91 °C |

Figure 2: Water temperature at the analyzed point

According to ANA (2020), temperature is one of the most important parameters, as it directly affects the physical and chemical processes carried out in water sources. In this environment, the existing organisms reach limits of upper and lower temperature variance, as they undergo changes throughout the day and in the changes of the seasons. Table 4 shows a demonstration of the relationship between temperature and aquatic life in some environments (ESTEVES, 1998).

Table 4: Relationship between temperature and aquatic life in lakes.

| TEMPERATURE | LEVEL     | AQUATIC LIFE                                |
|-------------|-----------|---------------------------------------------|
| < 14°C      | Low       | Few plants, trout and few diseases.         |
| From 15 a 20 °C | Medium   | Some plants, water beetles and some diseases. |
| From 21 a 27 °C | High     | Many plants, carp, catfish and many fish diseases. |
| > 27 °C     | Very High | Temperature begins to reduce aquatic life.   |

Source: Esteves (1998).

According to the results obtained, the temperature is at a high level where there is a proliferation of many plants, carp, catfish and many fish diseases.

Dissolved oxygen

Oxygen (O$_2$), is a gas of great biological importance and in water it participates in numerous chemical reactions in aquatic ecosystems. All heterotrophic organisms depend on one form or another of oxygen to maintain the metabolic processes of production and energy and reproduction. The main sources of oxygen for water are the atmosphere and photosynthesis. On the other hand, losses occur due to the consumption and decomposition of organic matter (oxidation), to the atmosphere, by the breathing of aquatic organisms and by the oxidation of metal ions such as, for example, iron and manganese (ESTEVES, 1998).

The highest value of Dissolved Oxygen according to table 5, occurred in the first collection of February, having a value of 5.11 mg.l$^{-1}$, while the lowest value was in the fourth collection of March,
registering 4.98 mg. l⁻¹. Figure 3 presents a graph of the Dissolved Oxygen values.

Table 5: Average of dissolved oxygen.

| Date  | Score       |
|-------|-------------|
| Feb/20| 5.11 mg.l⁻¹ |
| Feb/20| 4.99 mg.l⁻¹ |
| Mar/20| 5.01 mg.l⁻¹ |
| Mar/20| 4.98 mg.l⁻¹ |
| Mar/20| 4.99 mg.l⁻¹ |
| Mar/20| 5.03 mg.l⁻¹ |
| Average: | 5.02 mg.l⁻¹ |

![Figure 3: Oxygen dissolved from the analyzed point.](image)

According to Resolution 357/2005 of the National Environment Council (CONAMA), it establishes that the concentration of dissolved oxygen must be equal to or greater than 5 mg.L⁻¹ for Class 2 waters, which means that the results obtained are on average within the standard, with some collections showing values slightly below, a warning sign for the competent bodies.

Biochemical demand for oxygen (DBO)

The highest DBO (Biochemical Oxygen Demand) occurred in the second sample of February, with a result of 2.01 mg / L⁻¹, while the lowest was in the first sample of February with 1.66 mg / L⁻¹. The results obtained are within the parameters of CONAMA Resolution 357/2005, where for class 2 waters, the value must be up to 5 mg / L⁻¹ O₂. Table 6 shows the average DBO values. Figure 4 shows the Biochemical Oxygen Demand values. The presence of high DBO values results from the decrease in the dissolved oxygen values in the water, directly interfering in the balance of aquatic life. Generally, the high values of this parameter in a body of water are caused by the release of organic loads, mainly domestic sewage (CETESB, 2009).

Table 6: Average biochemical demand for oxygen.

| Date  | Score       |
|-------|-------------|
| Feb/20| 1.66 mg/L⁻¹ |
| Feb/20| 2.01 mg/L⁻¹ |
| Mar/20| 1.67 mg/L⁻¹ |
| Mar/20| 1.74 mg/L⁻¹ |
| Mar/20| 1.72 mg/L⁻¹ |
| Mar/20| 1.81 mg/L⁻¹ |
| Average: | 1.77 mg/L⁻¹ |
According to Vieira (2015) pH is able to influence many chemical and biological processes in water bodies, in addition to processes associated with the supply and treatment of wastewater. It can be influenced by several factors, such as dissolved solids and gases, hardness and alkalinity, temperature and biotic factors. The pH varies between 0 and 14 (very acid to very alkaline), because this is a factor that interferes in the species’ metabolism, CONAMA established limits for Class 2 waters, by means of resolution 357/2005 where the values must remain 6 to 9 (ANA, 2020). Table 7 presents the average of the Hydrogenionic Potential, obtaining an average of 7.11 being within the range stipulated by CONAMA resolution 357/2005. Figure 5 shows the values for Hydrogenionic Potential.

### Table 7: Average hydrogenionic potential.

| pH   | SCORE |
|------|-------|
| Feb/20 | 7.34  |
| Feb/20 | 7.45  |
| Mar/20 | 7.16  |
| Mar/20 | 6.91  |
| Mar/20 | 6.87  |
| Mar/20 | 6.92  |
| AVERAGE: | 7.11  |

During this period, the pH went through oscillations, but remained within the range allowed by CONAMA Resolution 357/05, which recommends pH values around 6.0 to 9.0 for water sources. The maximum value of 7.45 indicated is slightly acid.
Turbidity

Turbidity is the parameter in which water's ability to disperse solar radiation is analyzed, being influenced mainly by suspended solids, which reduce the photosynthesis of submerged vegetation. In general, turbidity comes from the erosion of large amounts of solids in the drainage area of the reservoir's tributaries and the entire hydrographic basin (TAVARES, 2005). Table 8 shows the turbidity values, in which in February the highest values were recorded due to large amounts of precipitation, with values of 6.7 NTU and 6.87 NTU in the first and second week, and the lowest value was recorded in the third week due to the decrease in the volume of rain, registering a value of 3.96 NTU. Figure 6 shows the Turbidity values.

| TURBIDITY | SCORE |
|-----------|-------|
| Feb/20    | 6.70  |
| Feb/20    | 6.87  |
| Mar/20    | 3.96  |
| Mar/20    | 4.37  |
| Mar/20    | 5.89  |
| Mar/20    | 4.53  |
| AVERAGE:  | 5.39  |

Based on the analysis carried out, it is possible to compare the results with the maximum permissible values, as established by CONAMA Resolution 357/05, where the turbidity values are based on the use of water, where the permitted value for treated water is 1 NTU at the exit of the water treatment plants and 5 NTU at any point in the distribution network. The variation in turbidity in surface waters is important for its relationship with the dissolved oxygen content due to the suspended solids making it difficult for solar radiation to penetrate, causing a decrease in photosynthetic activity (CONAMA, 2005). Despite the average presenting a value higher than 5 NTU, the maximum allowable value for CONAMA Resolution 357/05 for water anywhere in the distribution network, it is important to highlight the rainy season that may have influenced the values of some collections that are at odds.

Total dissolved solids (SDT)

All water impurities, with the exception of dissolved gases, contribute to the concentration of solids in water bodies and can be called waste, since, after evaporation of a sample and drying in the oven, these
materials remain. The smaller particles, capable of passing through a specified filter paper, correspond to the total dissolved solids (VIEIRA, 2015). Table 9 shows the average of the Total Dissolved Solids, where an average of 17.93 mg.L⁻¹ was obtained, having recorded in the first week of March the highest recorded value of 26.3 mg.L⁻¹, and the lowest in the second reading in February, having registered 10.4 mg.L⁻¹, Figure 7 shows the values of Total Dissolved Solids.

Table 9: Total solved average solids average.

| SDT   | POINT (mg.L⁻¹) |
|-------|----------------|
| Feb/20| 11.96          |
| Feb/20| 10.4           |
| Mar/20| 26.3           |
| Mar/20| 21.1           |
| Mar/20| 18.9           |
| Mar/20| 18.9           |
| AVERAGE:| 17.93         |

Figure 7: Total dissolved solids from the analyzed point.

For Resolution 357/2005 the maximum allowed value for Class 2 waters is 500 mg.L⁻¹. The Ministry of Health established in Ordinance 518/2004, that the maximum allowed value for human consumption is 1000 mg.L⁻¹. All values are much lower than allowed.

**Total nitrogen**

According to ANA (2015), water that contains high concentrations of organic and ammoniacal nitrogen, in addition to small concentrations of nitrites and nitrates cannot be considered safe, as it indicates that the site has had recent contamination. Eutrophication is the main problem related to high concentrations of nitrogen, as it can lead to an overgrowth of algae, causing interference to the desirable uses of water (VON SPERLING, 2005).

Table 10: Average total nitrogen values.

| TOTAL NITROGEN | POINT (mg.L⁻¹) |
|----------------|----------------|
| Feb/20         | 1.981          |
| Feb/20         | 2.245          |
| Mar/20         | 1.953          |
| Mar/20         | 1.913          |
| Mar/20         | 1.862          |
| Mar/20         | 1.512          |
| Average:       | 1.911          |

Table 10 shows the values of the average Total Nitrogen, where the highest concentration occurred
in the second analysis of February, having registered 2.245 mg/L⁻¹, while the lowest was in the last analysis in March, registering 1.512 mg/L⁻¹. Nitrogen is an element of fundamental importance to the life of organisms, since it is an integral part of the protein molecule, and consequently, of the protoplasm. Along with phosphorus, it is considered one of the most important and life-limiting of freshwater organisms (BOLLMANN et al., 2005). Figure 8 shows the values of Total Dissolved Solids.

![Total Nitrogen](image)

**Figure 8:** Total nitrogen from the analyzed point.

The maximum value of total nitrogen for Class 2 waters, according to CONAMA resolution 357/2005, varies according to the hydrogen potential (pH). For PH ≤ 7.5 the maximum allowed value is 3.7 mg/L⁻¹, for 7.5 <pH ≤ 8.0 the maximum allowed limit is 2 mg/L⁻¹, for 8.0 <pH ≤ 8.5 the maximum allowed value is 1 mg/L, for pH values greater than 8.5 the maximum allowed value is 0.5 mg/L⁻¹. According to table 7, both the average pH and the highest recorded pH reading are less than 7.5, so the maximum allowed value for Total Nitrogen is 3.7 mg/L⁻¹, thus all analyzes of the six collections are within the parameter, with the largest analysis being 2.245 mg/L⁻¹.

**Total phosphorus**

For Vieira (2015) phosphorus is a fundamental nutrient for maintaining the life of living organisms and, in water, it is found in the form of phosphate, both in its dissolved form and as particulate material. Natural sources of phosphate are the chemical weathering of rocks, as well as the decomposition of organic matter. Sewers are major contributors to the increase in the concentration of phosphorus in the waters, a fact that, in the case of a high concentration of sewage in the water body, can lead the environment to eutrophication, since phosphorus is a limiting nutrient for the growth of seaweed.

CONAMA Resolution 357/2005 for waters with class 2 lentic environments, establishes a maximum limit of 0.030 mg.L⁻¹ and for lotic environments 0.1 mg. L⁻¹. The source of the intense ecological interest in phosphorus stems from its great importance in the metabolism of the biosphere (CONAMA, 2005). In the six analyzes carried out in the months of February and March, the values found for total phosphorus were all equal to 0, indicating that in the studied period there is no presence of such substance at the point where the collection was made.
Fecal coliforms

According to CONAMA Resolution 375/2005, it says that fecal or thermotolerant coliforms are:

Gram-negative bacteria, in the form of bacilli, negative oxidase, characterized by the activity of the enzyme β-galactosidase. They can grow in media containing surfactants and ferment lactose at temperatures of 44° - 45°C, with production of acid, gas and aldehyde. In addition to being present in human and homeothermic animal fees, they occur in soils, plants or other environmental matrices that have not been contaminated by fecal material.

Table 11 shows the average of the values obtained from the analysis of Fecal Coliforms, in which it quantifies the presence of the bacteria of the Escherichia coli group. In all collections there is the presence of fecal coliforms, however in the second collection of February and in the fifth collection of March there was no presence of the bacteria, the highest value was in the fourth collection in March, having been recorded a value of 70.1 MPN /100ml. Figure 9 shows the values of Fecal Coliforms.

Table 11: Average fecal coliforms values.

| FECAL COLIFORMS | POINT (NMP/100 ML) |
|-----------------|--------------------|
| Feb/20          | 3,1                |
| Feb/20          | 0                  |
| Mar/20          | 9,1                |
| Mar/20          | 70,1               |
| Mar/20          | 0                  |
| Mar/20          | 16,3               |
| AVERAGE:        | 16,43              |

Figure 9: Fecal coliforms from the analyzed point.

CONAMA resolution 357/2005 defines for Class 2 waters that the value must be less than 1000 Most Probable Number (NMP)/100 ml, whereas for CONAMA resolution 274/2000 these values must be less than 2000 NMP/100 ml. The low values found are due to the fact that close to the analyzed point is a closed condominium subdivision area that has not yet been inhabited, however there was the presence of faecal coliforms in all collections, nearby neighborhoods can also affect water quality during rainy season. , where runoff occurs.

Water quality index (IQA-NSF)

The results obtained for the months of February and March 2020 served as a basis for calculating the IQA through the physical, chemical and bacteriological parameters of the surface waters of Lake UHE Lajeado in the municipality of Porto Nacional, using as parameters the classification of values by the National...
Sanitation Foundation. The calculation was performed using Excel as a support tool.

Table 12 shows the values of the Water Quality Index (IQA NSF), which shows the values of the 6 collections carried out between the months of February and March, in addition to the average. The lowest IQA value recorded was 76.21 in the second week, while the highest was 79.46 in the sixth week, very close values. The period under analysis obtained an average of 77.97, a value classified as good according to table 2, where the standard IQA value of the National Sanitation Foundation for such category is 70 <IQA ≤ 90. The little variation recorded during all collections shows that the point chosen to collect water to supply the population of the municipality of Porto Nacional - TO was made in a very satisfactory manner by the company BRK (basic sanitation company that operates in the region).

| NSF     | DATE       | POINT IN ANALYSIS |
|---------|------------|-------------------|
|         | 19/02/2020 | 79,17             |
|         | 26/02/2020 | 76,21             |
|         | 04/03/2020 | 78,94             |
|         | 11/03/2020 | 76,52             |
|         | 18/03/2020 | 77,56             |
|         | 25/03/2020 | 79,46             |
| AVERAGE |            | 77,97             |

All the results of the analyzed parameters were within the permitted standards when analyzed separately, always within the limits established by CONAMA Resolution 274/00, 357/05 and NSF, with little variation in the samples collected during the 6 weeks. Factor that contributed to the final value of the IQA to obtain a satisfactory result.

CONCLUSIONS

The result obtained from the analysis of water quality was of great relevance, in which it was able to analyze the real state of the water that is serving for public supply. Monitoring the IQA serves mainly to monitor the evolution of the water quality of the place, making it possible to create a history for analysis, serving mainly as an alert to the population and the responsible bodies, so that preventive measures can be taken when it becomes necessary.

The results obtained during the study period with regard to the change in water quality, allowed a good analysis of the studied site, concluding that the waters of Lake UHE Lajeado in the municipality of Porto Nacional - TO met the specifications of CONAMA Resolution 357/2005 for class two waters, in almost all 9 water quality parameters, except for the turbidity that was at odds. Therefore, it is classified as good according to the IQA classification of the National Sanitation Foundation.

Despite the satisfactory result obtained with the study, it is worth mentioning that the care with the waters and soils of the hydrographic basin must be continuous, because even if the majority of the values were within the parameters, there were still those that came close to or exceeded the limit (Oxygen Dissolved and Turbidity), this shows that monitoring is of great importance and that precautionary measures must be taken so that the current situation does not worsen.
Another factor that may have influenced what made it possible to obtain good results is the fact that the analyzed point is located outside the city within a condominium not yet inhabited, and around it there are few residences. This situation can be changed if there is no good management in urban expansion in the region, mainly with the treatment of sanitary sewage and the release of solid waste, which are one of the causes that contribute to the pollution of watersheds.

The use of the IQA leads to the conclusion that its use is fundamental for the preservation of water resources, because with this important tool you will be able to outline goals and management plans so that there is a better preservation of this resource, which is fundamental to life. Therefore, the point used to collect water for urban supply purposes at the UHE Lajeado lake in the municipality of Porto Nacional - TO is in good condition.

REFERENCES

ANA. National Water Agency. Caring for Waters: Solutions to improve the quality of water resources. 2 ed. Brasilia: ANA, 2013.

ANA. National Water Agency. Quality Indicators - Water Quality Index (AQI). Brasilia: ANA, 2020.

APHA. American Public Health Association. Standard methods for the examination of water and wastewater. 21 ed. Washington: APHA, 2007.

BOLLMANN, H. A.; CARNEIRO, C.; PERGORINI, E. S.. Water Quality and Nutrient Dynamics. In: ANDREOLI, C. V.; CARNEIRO, C.. Integrated Management of Eutrophic Supply Sources. Curitiba: Gráfica Capital LTDA, 2005. p.213-270.

CETESB. Environmental Company of the State of São Paulo. Inland Water Quality in the State of São Paulo: Environmental and Sanitary Significance of Water and Sediment Quality Variables and Analytical and Sampling Methodologies. São Paulo: CETESB, 2009.

CONAMA. National Environment Council. Resolution 357, of March 17, 2005. Brasilia: CONAMA, 2005.

DETONI, T. L.; DONDONI, P. C.. Water scarcity: a global view on sustainability and academic awareness. Rev. Ciênc. Admin., Fortaleza, v.14, n.2, p.191-204, 2008.

ESTEVES, F. A.. Fundamentals of Limnology. 2 ed. Rio de Janeiro: Inter Ciência, 1998.

HELLER, L.; PÁDUA, V. L.. Water supply for human consumption. 2 ed. Belo Horizonte: UFMG, 2010.

REBOUÇAS, A.. Intelligent use of water. São Paulo: Escritura Ltda, 2004.

ROSSI, W.; BRANCO, L. C.; LACERDA, J. A.; GOMES, A. C.; WAGNER, E. M. S.. Sources of Pollution and the Control of Environmental Degradation of Urban Rivers in Salvador. Interdisciplinary Journal of Social Management, v.1, n.1, p.61-74, 2012.

SELBORNE, L.. The ethics of using fresh water: a survey. Brasilia: UNESCO, 2001.

SETTI, A. A.; LIMA, J. E. F. W.; CHAVES, A. G. M.; PEREIRA, I. C.. Introduction to water resource management. Brasilia: Aneel, 2000.

TAVARES, A. R.. Monitoring the quality of the waters of the Paraíba do Sul River and diagnosing conservation. Dissertation (Master) - Instituto Tecnológico de Aeronáutica, São José dos Campos, 2005.

TUCCI, C. E. M.. Is there a water crisis in Brazil?. 2009.

VIEIRA, B. M.. Evaluation of water quality and its compatibility with uses in rural watersheds with quantitative water deficit. Dissertation (Master Environmental Engineering Course) - Technological Center, Federal University of Espirito Santo, Vitória, 2015.

VON SPERLING, M.. Introduction to water quality and sewage treatment. 3 ed. Belo Horizonte: UFMG, 2005.

YISA, J.; JIMOH, T. O.; OYIBO, O. M.. Underground Water Assessment using Water Quality Index. Leonardo Journal of Sciences, p.33-42, 2012.