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The Current Status and Solutions for Urban Water Environment in Hanoi City

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ABSTRACT

Combined sewer system in the inner Hanoi city is one of the challenges for water drainage work when heavy rains happen, and making waste water treatment costly. Main waste sources of Hanoi urban area consist of: Domestic waste, hospital waste, and industrial waste. Hanoi has been planning some centralized waste water treatment plant which solves a number of current issues in temporarily period, but long-term and efficient measures are needed for sustainable development. "Waste water separation and treatment at sources" would bring economic efficiency, and sustainable development for human health and environment. Some solutions have been studied and will be discussed more detail in this report. The proposal includes: Establish medical waste water treatment system meeting National Technical Regulation in hospitals; Build up waste water collection and treatment system in residential areas; Set up waste water treatment system meeting requirements of National Technical Regulation in the industrial zones before discharging to combined sewer system.

1. INTRODUCTION

After the sixth congress of the party in 1986, Viet Nam has developed economy towards market economy and focus development towards industrialization and modernization. Along with economic development, urbanization process is quick and powerful. So far, Hanoi is listed among the cities with high densities in the world (according to 2014 statistics, as of December 2013, the average population density in the inner city Hanoi at about 22,000 people/km², especially, Dong Da district with density up to 40,000 people/km²)[1]. It is the fastest and rapid growing for a long time and recently led to many consequences when the old infrastructure does not meet the development leads to increased environmental pollution in general, water urban particular is one of the prominent environmental problems in the city of hanoi today.

The main sources of pollution in urban inner city Hanoi include: domestic waste water from the source of residential areas and source of commercial services is estimated at 723,000 m³/day in which wastewater in urban area: approximately 600,000 m³/day, wastewater from the hotels and commercial centers - tourism: 123,000 m³/day.[2]. The total volume of wastewater from industrial parks, industrial clusters in Ha Noi is estimated around 80,000 m³/day;The total volume of Medical waste water discharged daily at approximately 6,000 m³/day.[3].

In this study we focused on the research assessment of water quality in rivers inner Hanoi; wastewater in some inner city hospitals Hanoi; wastewater in some industrial areas of the inner city Hanoi, through the chain of several years of observation data of Hanoi center for natural resources monitoring and environmental analysis. Research using

the statistical method, comparative analysis to assess the quality of water from the source of pollution to surface water on the rivers inner Hanoi. Since it launched measures to improve water quality in these river while providing appropriate solutions to improve water quality in the main pollution sources.

2. SUBJECTS AND STUDY METHODS

2.1. Subjects

Subjects were selected in the study include: wastewater at a hospital in the inner city of Hanoi; waste water of a number of industrial parks in Hanoi; surface water in the rivers inner Hanoi city;

Sampling site:

Hospital waste water: at the location after the wastewater treatment system of the hospital or at the location of the discharge of the sewer system of the hospital into general sewer system of the city. The selected hospitals for assessment in this study include: Cancer Hospital, Central Hospital Hematology and Blood Transfusion, Central Hospital of Endocrinology, Hospital of Transport, Central Children's Hospital, Hanoi Friendship hospital, Obstetric hospital, Dong Da Hospital. The data used to evaluate the quality of hospital waste water were collected in the period from 2009 to 2013.

Waste water in the industrial parks: at the location of industrial sewage before discharge into general sewer system of the city. Selected industrial parks for the research include: Chem IP, Cau Dien P, Phap Van, Van Dien, Cau Buou, Thuong Dinh, Mai Dong, Nam Thang Long. The data used to assess the quality of industrial waste water is monitored data from 2008 to 2012 of Hanoi Center for Environmental and Natural Resources Monitoring and Analysis
Surface water in the rivers inner of Hanoi city: at 26 monitoring sample sites along the rivers: Set river (4 sample sites), Lu river (4 sample sites), Kim Nguu river (4 sample sites), To Lich river (14 sample sites). The data used to assess the quality of surface water is monitored data from 2009 to 2013.

Sampling frequency:

Waste water from hospitals: 1 time/year

Waste water in the industrial parks: 2 times/year in dry and raining season.

Surface water in the rivers inner of Hanoi city: 2 times/year in dry and raining season.

The monitoring parameters:

Waste water from hospitals: : pH, COD, BOD₅, TSS, NH₄⁺, NO₃⁻, Octophosphate (based on PO₄³⁻), total Oil, S₂⁻, total Coliform, Salmonella, Shigella, Vibrio cholera.

Waste water in the industrial parks: pH, COD, BOD₅, TSS, Cl⁻, F⁻, CN⁻, S₂⁻, Phenol, As, Fe, Cd, Pb, Cr⁶⁺, Cr³⁺, Hg,

Cu, Zn, Ni, total N, total P, Mn, total Oil, Surfactant, total Coliform.

Surface water in the inner of Hanoi city: pH, DO, COD, BOD5, TSS, NH4+, Cl-, F-, NO-3, NO-2, CN-, PO43-, Phenol, As, Fe, Cadimi, Pb, Cr6+, Cr3+, Hg, Cu, Zn, Ni, total Oil, Surfactant, total Coliform.

2.2. Study Method

Using statistical method, compare: String data is used to calculate the results observed for many years, on the basis of applicable regulations allowed for each type of waste water compared with the permitted Regulation that assess water quality.

Regulations applicable to evaluate the quality of hospital wastewater: Value column B of Regulation industrial wastewater QCVN 28: 2010/MONRE; Regulations applied to evaluate the quality of industrial wastewater: Value column B of Regulation industrial wastewater QCVN 40: 2011/MONRE; Regulations applied to assess water quality: Value column B2 of surface water quality standards QCVN 08: 2008/MONRE.

3. RESULTS AND DISCUSSION

3.1. Results of monitoring the quality of hospital wastewater

Waste water quality monitoring at several of beyond allowable NTR as following:

Organic substances

BOD5: BOD5 content range from 5-276mg/l, there are 25/40 monitoring results giving the BOD5 value beyond allowable NTR.

Nutrients

NH4+: There are 31/40 monitoring values with high ammonium contents exceeding NTR, ranging from 0.1 to 69.3mg/l. The hospitals that have high ammonium content are Central Hospital Hematology and Blood Transfusion and Central Hospital for Children.

Coliform: total coliform contents in all the hospitals are very high, ranging from 900 to 1.1*10⁹ MPN/100ml and there are 35/40 values many times higher than QCVN 28: 2010/MONRE(B colum).

The pathogenic microorganisms such as Salmonella, Cholera: Bacterial pathogens are still found in the monitoring results in the Central Hospital Endocrinology, Hanoi Maternity hospital and Dong Da Hospital. This suggests that the risk of the disease from spreading organisms into the water environment is high.

3.2. Results of monitoring data of industrial wastewater

Monitoring data in several of industrial parks, industrial clusters as follows: some typical parameters exceed NTR as following:

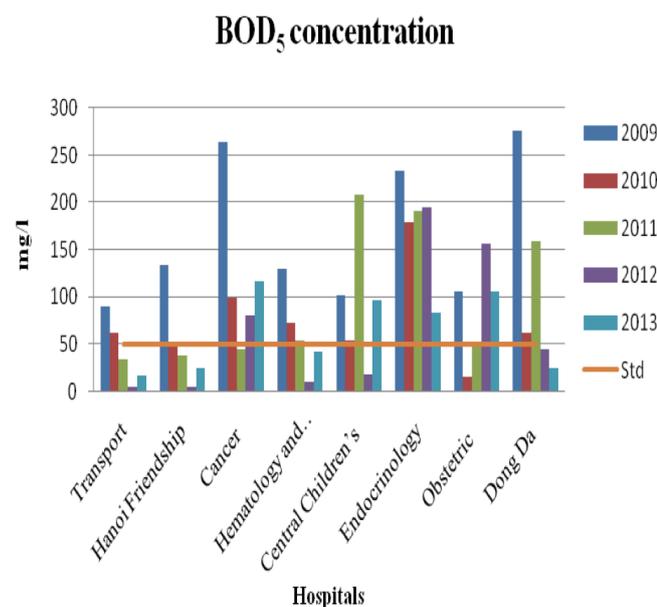


Figure 1: Graph of the monitoring results BOD5 concentrations in sewage some hospitals in the inner Hanoi city.[4]

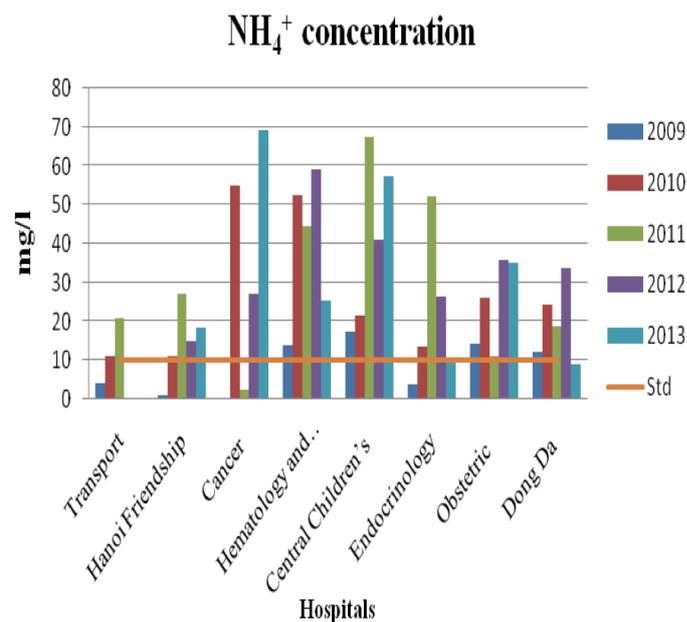


Figure 2: Graph of the monitoring results NH4+ concentrations in sewage some hospitals in the inner Hanoi city.[4]

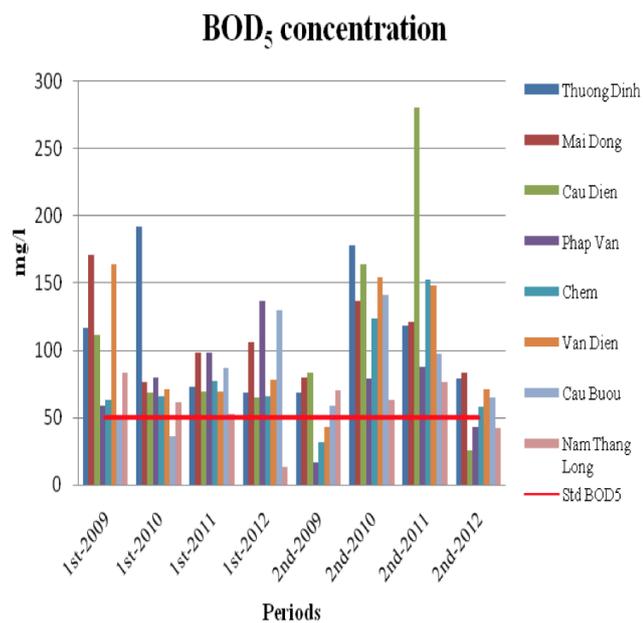


Figure 3: Graph of the monitoring results BOD5 concentrations in sewage some industrial zones in the inner Hanoi city.[5]

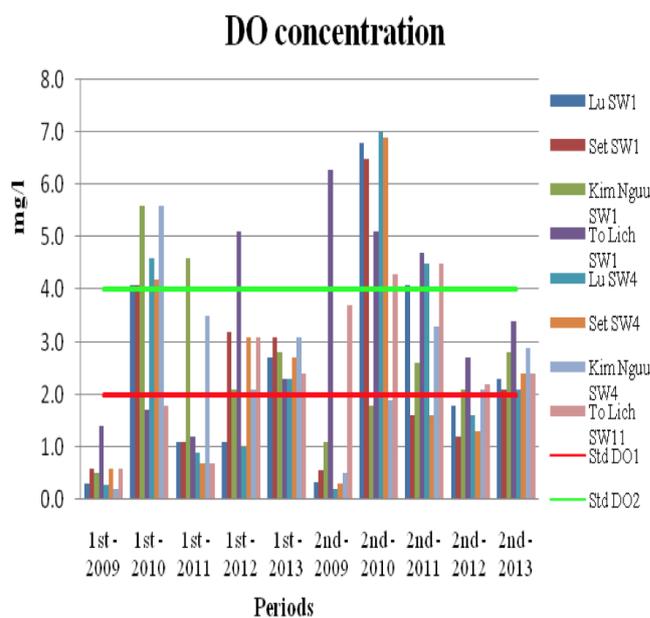


Figure 5: Graph of the monitoring results DO concentrations in the rivers inner Hanoi city.[6]

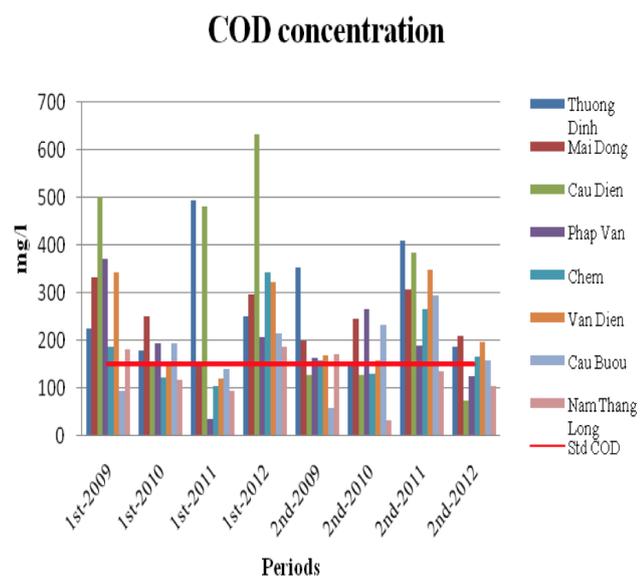


Figure 4: Graph of the monitoring results COD concentrations in sewage some industrial zones in the inner Hanoi city.[5]

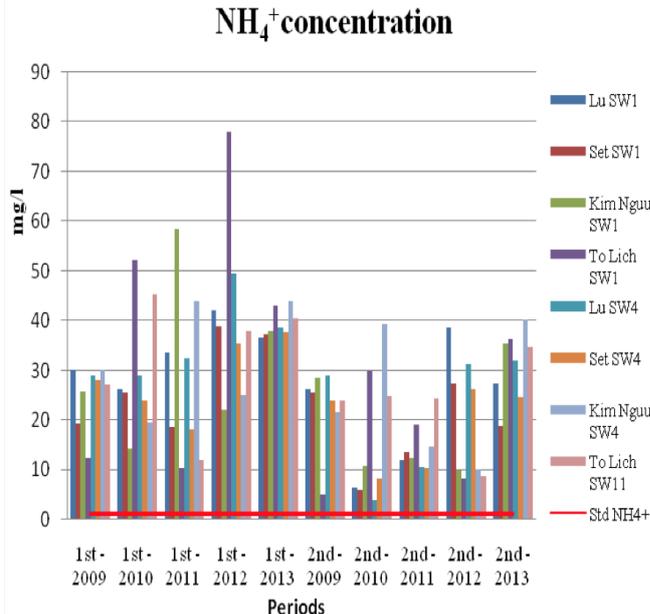


Figure 6: Graph of the monitoring results NH4+ concentrations in the rivers inner Hanoi city.[6]

Organic substances

BOD5: BOD5 content ranges from 13-281mg/l, there are 56/64 monitoring results giving BOD5 beyond NTR.
COD: COD value ranges from 33-634mg/l, with 43/64 monitoring results having COD values exceeding NTR. The IPs that have high COD contents are: Cau Buou (295 mg/l), Mai Dong (333 mg/l); Cau Dien (634 mg/l); Phap Van (375

mg/l); Chem (343 mg/l).

Nutrients: total nitrogen content in the monitored Ips has values 37- 88.7mg/l, with 20/64 monitoring value results exceeding NTR. The IP that often have value exceeding NTR is Mai Dong IP. NH4+: There are 45/64 monitoring results with high ammonium contents exceeding NTR from

1.1 times to 7.6 times. The industrial parks that have high contents of ammonium are Phap Van, Thuong Dinh, Cau Dien.

Coliform: total coliform contents are relatively high and exceed QCVN 40: 2011/MONRE (B column).

Heavy metal: Most content of heavy metals (Cu, As, Pb, Hg, Cd) meet QCVN 40: 2011/MONRE (B). Particularly, values of Hg, As in Van Dien Industrial Park QCVN exceed permitted NTR. For Cr, Mn, Ni, the values in Nam Thang Long only exceed the NTR.

3.3. Results of monitoring water quality in the rivers inner city Hanoi

Through the results of monitoring water quality in the rivers inner city Hanoi there are some remarks as following: Dissolved oxygen concentration (DO) in the surface water of the rivers is low, below the level of development of some species (> 4). During the dry season the measured value is lower than the rainy season. DO values at monitoring sites in the river range from 0.1 to 7 mg/l. There are 33% of the monitoring values of DO lower than NTR (<2mg/l).

BOD5 contents beyond the allowable limit of NTR from 1.1 to 20 times (There are 33% of the monitoring values exceeded NTR). COD values at all monitoring sites exceed NTR from 1.1 – 10 times (There are 97% of the monitoring values exceed NTR). The result showed that the level of organic pollution in the river is high.

Nutrients: NH4+: contents of ammonium at all positions are higher than NTR exceed the limit of NTR from 9.75 to 58.5 times. PO43-: phosphate contents at all monitoring sites exceed NTR from 1.2 – 52 times.

Oil total: total oil contents at monitoring sites are rather high, ranging 0.1 to 18.8 mg/l. Proportion of samples exceeding NTR accounts for 97%, from 1.3 to 66 times.

Coliform: total coliform contents are at high levels, ranging from 2,300 -110,000,000 MPN/100ml.

Heavy metals: there are heavy metal pollution in the river as for Fe, there are 23% values exceeding NTR, from 1.1 to 20 times higher than NTR; and Cr6+ (10.8% values exceeding NTR, from 1.3 to 4 times higher than NTR).

4. DISCUSSION

Through the monitoring results of water quality in the inner city of Hanoi some hospitals and several industrial zones, some remarks can be given as follows:

Water quality in the river city Hanoi was organic pollution, eutrophication, microbial contamination at high level and signs of heavy metal pollution (Fe, Cr6+).

Waste water at the hospital were organic pollution, nutrient (NH4+) at high level. Especially, total coliform were polluted at high level and the microorganisms that cause infectious disease outbreaks services such as Salmonella, Cholera is still found in the effluent of some hospitals. Waste water discharge points at the end positions of some industrial were organic pollutants, especially, nutrients and pollutants signs of toxic heavy metals such as Hg, As Van Dien Industrial zone, heavy metals Cr, Mn, Ni Nam Thang Long Industrial zone.

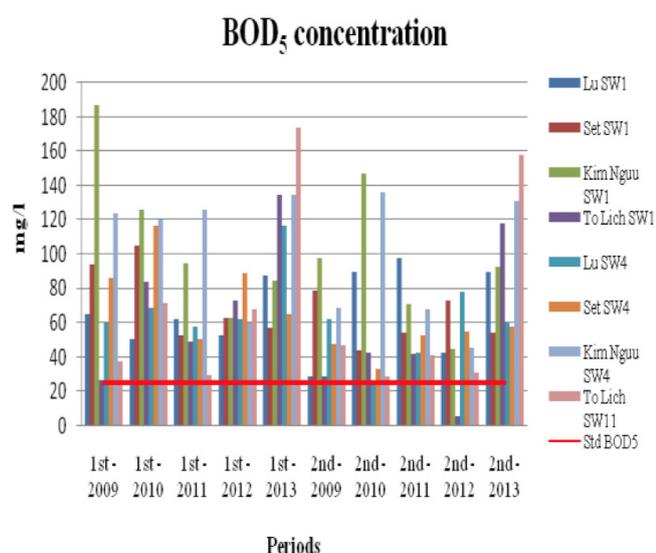


Figure 7: Graph of the monitoring results BOD5 concentrations in the rivers inner Hanoi city.[6]

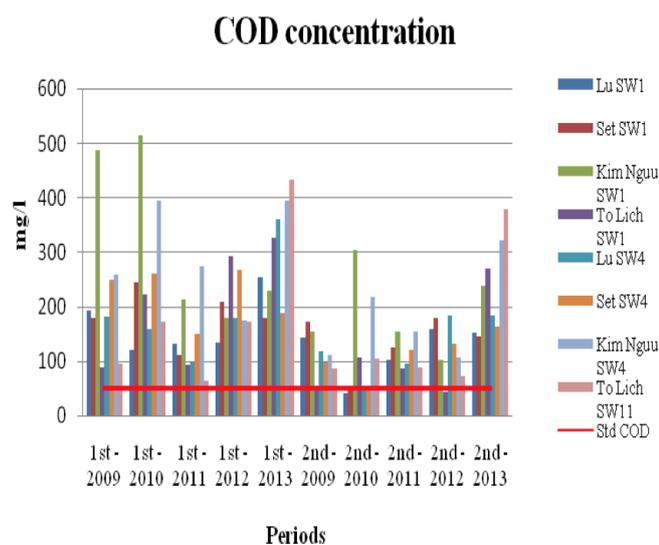


Figure 8: Graph of the monitoring results COD concentrations in the rivers inner Hanoi city.[6]

In order to limit and control the impact of waste water on the environment and human health should be the appropriate solution to the situation and condition of each object mitigation. Thereby, maximizing the possibility of reducing the minimum negative impacts of wastewater on the environment and human health.

5. THE SOLUTIONS

Regarding the current wastewater treatment system: the existing wastewater treatment plant in the city meet only 20% percent of the city waste water. The remain untreated is discharged into the sewer system and pumped partially to the Red River and Nhue cause pollution to the river receives waste sources. The implications of this directly affects the quality and productivity of crops, species and ecosystems in downstream of Nhue Day river. There should be measures to reduce the components of pollutants from the

1. Construct medical waste water treatment system meeting National Technical Regulation in 100% of hospitals, clinical institutions in Hanoi (currently, there are 50% of hospital in Hanoi having waste water treatment system). According to data from inspection reports of Hanoi department of Natural Resources and Environment in 2013, 41 hospitals, clinicals under Hanoi Medical management were checked and the results are: There 27 per 41 hospitals and clinical have wastewater treatment (accounted for 66%). Among 27 hospitals have waste water treatment system, 56% of the hospital have waste water quality meet the NTR before discharge into the general system, the remaining 44% do not meet); 14 per 41 hospitals have no wastewater treatment systems. [7].

2. From the results of environmental monitoring hospital wastewater showed that the monitoring frequency 1 time / year is not enough to control the quality of hospital wastewater and make decisions on sanctions or as a base for other remedies. There is request to build the wastewater quality monitoring program at the hospitals with frequency at least 4 times per year.

3. Another issue in management levels: Wastewater after discharge into the sewer system will be shared by the city authorities who are responsible for collecting and treatment such as drainage companies, wastewater treatment company, ... Department of Natural Resources and Environmental police will conduct the checking, monitoring and sanctioning the organization which cause pollution. In fact, a large number of medical research institutions, hospitals under of the Ministry of Health and other ministries, which is not under the supervision of the Hanoi Environmental Department (DONRE). They are belong to the management of the Environmental Management Bureau of Ministry of Health. Therefore, the evaluation of the treated waste-

water quality in these hospitals are not objectively when there is no monitoring from independent party.

4. Due to land in the urban area cramped irrelevant for the rehabilitation of sewer separately. Thus the construction of the collection system and wastewater treatment in residential areas with 10,000 people / collection and treatment system and then transferred to the treatment plant is necessary. Besides, the apartment buildings, new urban areas should have wastewater collection system and wastewater treatment system before discharge to the combined sewer system of the city.

5. Industrial complexes and zones: 100% industrial complexes and zones have waste water treatment system meeting requirements of National Technical Regulation before discharging to combined sewer system. There are currently 7 per 8 industrial parks having centralized wastewater treatment systems coming into the stable operation. There are 47 per 107 industrial clusters do not have the construction item of wastewater treatment systems in the planning;

6. Solutions to enhance a awareness of community: Under many different forms such as: Communication and education for people to improve their knowledge, deep understanding of the importance of the use of water for the environment and human, implement education program for protecting the water environment in the school. This is long-term solution and the most effective.

7. The result of monitoring water quality in rivers showed that showed signs of heavy metal pollution, NH₄⁺ and microbial contamination at a high level. Therefore we need to regularly dredge the river system in the city to avoid contamination from surface water into ground water which affect domestic water supply quality in the city because the sources are mainly from groundwater.

6. CONCLUSION

Through the observation results in water pollution sources: industrial waste, hospital waste water, water in the river city of Hanoi shows the risk, potentially capable of direct influence environment and human health through direct contact or indirectly. This suggests that the increased risk of diseases related to water resources and the risk of outbreaks of diseases such as salmonella, cholera and other epidemic diseases.

Inner Hanoi city shares the sewerage system with the drainage system, as this is one of the difficult and expensive for the waste water treatment. Major sources of urban areas including domestic waste, hospital waste resources and industrial discharges. In the future, the city has planned a number of sewage treatment plants, however, focuses on the one hand to solve the situation, but in the long time

we need long-term solutions for the effective and sustainable development. The above solution given to wastewater treatment in resource efficient will contribute to improve and control the quality of waste water from the source of pollution is effective in terms of economic and sustainable development to human health and the environment for Hanoi city.

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