

MINISTRY OF EDUCATION AND TRAINING MINISTRY OF CONSTRUCTION
HANOI ARCHITECTURAL UNIVERSITY

CHU MANH HA

**MODELS AND SOLUTIONS OF REGULATING LAKE MANAGEMENT
FOR REGULATING RAINWATER AND MINIMIZING INUNDATION
IN THE URBAN CENTER OF HANOI CITY**

SPECIALIZATION OF URBAN AND CONSTRUCTION MANAGEMENT
Code: 62.58.01.06

SUMMARY OF DOCTORAL THESIS

HANOI – 2021

The thesis was completed at Hanoi Architectural University

Doctoral advisor: Assoc. Prof., PhD. Nguyen Lam Quang

Reviewer 1: Assoc. Prof., PhD. Nguyen Thi Ngoc Dung

Reviewer 2: Assoc. Prof., PhD. Doan Thu Ha

Reviewer 3: PhD. Vu Anh

The thesis is defended before the Thesis Evaluation Council of Hanoi Architectural University

At ...h....., 2021

Information about the thesis can be found at

1. National Library of Vietnam
2. Library of Hanoi Architectural University

INTRODUCTION

Rationale of the study

Urban regulating lakes are part of the urban drainage system and are also an important factor in ensuring the system works stably and minimizing urban inundation caused by rain and flood. In addition, the regulating lakes also play a role in improving microclimate conditions, creating landscape beauty and being places for cultural and sports activities... The lakes have become places for gathering and community activities of urban residents and also become a part of urban life.

Decision No.589/QĐ-TTg dated April 6, 2016 of the Prime Minister about approving the Adjustment of the orientation for development of urban and industrial water drainage in Vietnam to 2025 and a vision to 2050 which clearly states: *“Develop regulations for the management of regulating lakes, optimize and synchronize drainage regulating functions with ecological, landscape and other functions; determine the appropriate locations and size of the lakes to ensure maximum efficiency in regulating rainwater of the lakes according to specific economic, technical and environmental conditions in accordance with the urban construction planning ”.*

However, in addition to ensuring rainwater regulation and minimizing urban flooding, the management of regulating lakes in the central urban area of Hanoi must also harmonize the interests of all stakeholders in the exploitation and use of the lakes.

The current situation of the management of the reservoirs in the central urban area of Hanoi is still inadequate. The organizational structure, assignment and decentralization of the management of lakes, the responsibilities of authorities at all levels and specialized management agencies are overlapping, not really clear which leads to difficulties in assessing management effectiveness and in determining the responsibilities of organizations and individuals. The work of checking, inspecting and handling violations in the management of lakes is not really strict. Mechanism and policy on management of lakes are still slow to be reformed. Funding sources used for lake maintenance and maintenance are limited. Socialization and community participation in the management of reservoirs are still limited.

Therefore, the research topic of the thesis: *“Models and solutions of regulating lake management for regulating rainwater and minimizing inundation in the Urban Center of Hanoi City”* is both necessary and highly practical.

Research purposes

Propose models and solutions of regulating lake management for regulating

rainwater and minimizing inundation in the Urban Center of Hanoi City.

Object and scope of the research

- Object of the research: Manage regulating lakes to regulate rainwater and minimize inundation in urban areas.

- Scope of the research: Regulating lakes in the Urban Center of Hanoi City (in accordance with Decision No.1259/QĐ-TTg).

Research method

The following 5 basic methods are used in the research of the thesis: Survey and data collection method; general analysis method; inheritance method; expert consultation method; prediction method.

New contributions of the thesis

1. Proposing a technical solution to increase rainwater regulation capacity of the regulating lakes with techniques of sustainable drainage for the Urban Center of Hanoi City to respond to climate change.

2. Proposing solutions to adjust the drainage planning in the direction of separated distributing regulating lakes for each drainage basin in the Center of Hanoi City.

3. Proposing to establish Lake regulation and management Center under the People's Committee of Hanoi City that is the only focal agency assigned the task of comprehensive management of regulating lakes within the city.

4. Proposing management mechanisms and policies to encourage socialization in investment of building new lakes and renovating old lakes.

Scientific and practical significance of the research

a. Scientific significance

- The research results can be used as references for students, professionals, in the field of design, planning and operation management of regulating lakes in the urban drainage system in particular, and in urban management and technical infrastructure in general.

- Provide data and information on regulating lakes as a basis for the construction of operating procedures and management of lakes connected to the drainage system.

- Contribute to perfecting the management model of regulating lakes in order to regulate rainwater and minimize flooding in the urban area.

b. Practical significance

- To serve as a basis for specialized management agencies of Hanoi City, political, social and professional organizations in establishing organizational mechanisms and management apparatus, development of management mechanisms and policies and promulgation of regulations on the management of regulating reservoirs.

- Carry out detailed designs, technical designs, renovation construction as well as new construction of regulating lakes and smart water reservoirs, anti-flooding solutions for the Urban Center of Hanoi City.

Concepts and terms used in the thesis

The thesis introduced concepts and terms used in the thesis related to the management of regulating lakes.

The structure of the thesis

In addition to the Introduction, Conclusions and Recommendations, the Thesis includes 3 chapters:

Chapter 1: Overview of the management of regulating reservoirs to regulate rainwater and minimize urban inundation in the Urban Center of Hanoi City.

Chapter 2: Scientific basis for management of regulating lakes to regulate rainwater and prevent urban inundation.

Chapter 3: Propose models and solutions of regulating lake management for regulating rainwater and minimizing inundation in the Urban Center of Hanoi City.

CONTENT

CHAPTER 1: OVERVIEW OF THE MANAGEMENT OF REGULATING RESERVOIRS TO REGULATE RAINWATER AND MINIMIZE URBAN INUNDATION IN THE CENTER OF HANOI CITY

1.1. Overview of regulating lake management to regulate rainwater and minimize inundation for urban areas in the world and in Vietnam

1.1.1. Overview of regulating lake management in the world

a. Regulating lakes in Japan - Anti-flooding solutions in Tokyo

Over the past few decades, prolonged heavy rains have threatened to submerge many homes in Tokyo. In 1993, the Japanese Government decided to build an underground drainage canal in the outskirts of the urban area with a cost of 3 billion USD. By the end of 2013, there were 11 underground regulated lakes in Japan, with a capacity of 2 million m³. In addition, five more underground regulated lakes are under construction in five other rivers.

b. Combining flood drainage lakes with waterways in Kuala Lumpur, Malaysia

To solve the problem of traffic congestion and urban inundation, the Malaysian capital Kuala Lumpur decided to build a smart tunnel. This is a large tunnel that leads floodwater from the Sungai Klang River in the north to the Sungai Kerayong River, of which 4km consists of two freeway lanes solving traffic problems in the south of the city.

c. Management and operation of regulating lakes in Singapore

The area of Singapore is only 700 square kilometers with 6 million

inhabitants. This country prevents flooding by reusing water and stores rainwater.

Through river, culvert and canal system, rainwater in two-thirds of Singapore is fed into 17 reservoirs for treatment before use.

1.1.2. Overview of regulating lake management in some urban areas of Vietnam

1.1.2.1. Management of regulating lakes to regulate rainwater and minimize inundation in Ho Chi Minh City

In the rainwater drainage planning (plan 752), Ho Chi Minh City determined to build 6,000 km of drainage culverts by 2020, but currently only about 2,590 km are invested; 140 regulating lakes have to be built to support drainage, but no lakes have yet been completed. Dredging of canals also only reached 1% of the plan.

1.1.2.2. Management of regulating lakes in Hai Phong city

The management of the regulating lakes of Hai Phong city is implemented in accordance with Clause 4 of Article 11 (Management of storm water drainage and reuse of rainwater) and Clause 5 of Article 11 (Management and operation of regulating lakes) of Decision No. 47/2017/QĐ-UBND dated December 29, 2017 of the People's Committee of Hai Phong city on promulgating the Regulation on management of urban drainage activities in Hai Phong city.

1.2. Introduction to the Urban Center of Hanoi City

1.2.1. Location and geographic limit

According to the Capital Construction Master Plan up to 2030 with a vision to 2050, the Urban Center of Hanoi City was determined as shown in Figure 1.7.

1.2.2. Natural condition; 1.2.3. Socio-economic condition

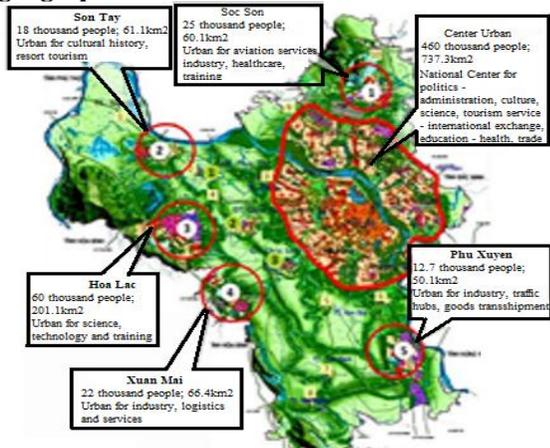


Figure 1.7. Diagram and boundary position of the Urban Center of Hanoi City according to the 2011 Capital Construction Master Plan.

1.3. Situation of regulating lakes in the drainage system of the Urban Center of Hanoi City

1.3.1. Situation of regulating lakes of the Urban Center of Hanoi City

Survey data in recent years shows that the number and area of water surface of the lakes in the Urban Center of Hanoi has decreased significantly.

1.3.2. Situation of rainwater - regulating basins zoning of the regulating lakes of the Urban Center of Hanoi City

Hanoi inner city area is divided into 3 main drainage basins: upstream drainage basins, middlestream drainage basins and downstream drainage basins.

Upstream drainage basin: This group includes two large lakes and a number of small lakes. Of which, West Lake and Truc Bach Lake have a total water surface area of 547ha.

Middlestream drainage basin of To Lich River: This group includes 20 small and medium sized lakes scattered in the basins of To Lich River, Lu River, Set River and Kim Nguu River with a total water surface area of 131.7ha.

Downstream drainage basin: This group includes 3 large lakes and a number of small lakes. In which, Yen So Lake, Linh Dam Lake and Dinh Cong Lake have water surface areas of 137ha, 76ha and 19.2ha respectively.

1.4. Situation of management of regulating lakes to regulate rainwater and minimize inundation in the Urban Center of Hanoi City

1.4.1. An overview of the drainage system and inundation situation of the Urban Center of Hanoi City

The drainage system of Hanoi City is a common sewer system. However, recently Hanoi has built some enveloped segments of sewers to

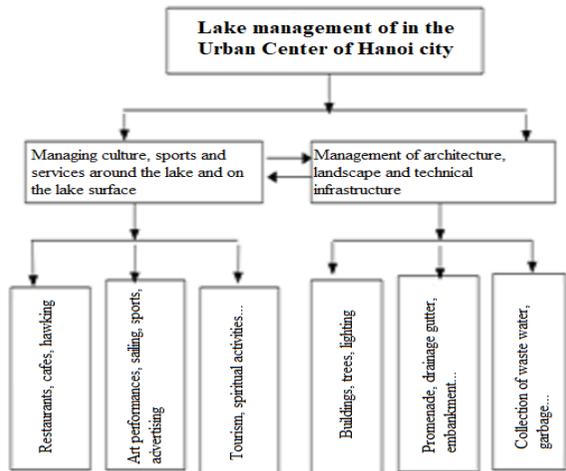


Figure 1.14. Diagram of the model of integrated functional management of the

separate wastewater from the system and built some treatment stations. According to statistics, with rain from 50mm to 100mm per hour, the city will have 18 points flooded.

1.4.2. Current status of investment in construction, renovation and use of regulating lakes

The city has also established many projects to renovate and maintain old lakes as well as build new lakes from the state budget as well as to call for investment from non-state budget sources.

1.4.3. Current status of the functional management of the regulating lakes of the Urban Center of Hanoi City

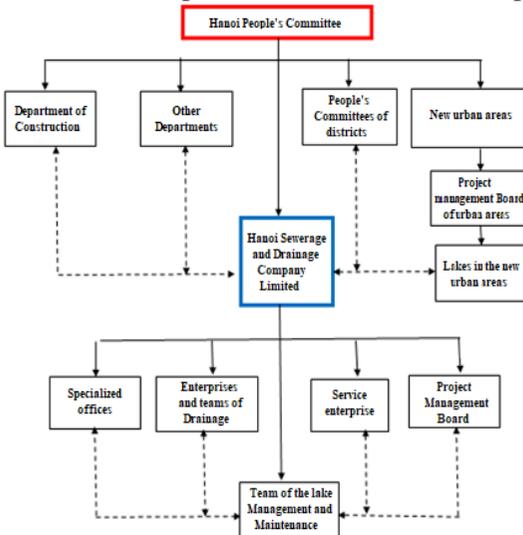
Include the status of: Architecture and landscape management; management of technical infrastructure of lakes; management of entertainment activities, sports and services; managing water level and ecological environment of lakes; manage and operate rainage pump stations, maintain regulating lakes.

1.4.4. Situation of mechanisms, policies and organizational structure and management of the regulating lakes in the Urban Center of Hanoi City

a. Mechanisms and policies

b. State structure and management of reservoirs of regulating lakes

The decentralization of the regulating lake management of Hanoi City was most recently amended and supplemented in Decision No. 41/QĐ-UBND dated September 19, 2016 of the People's Committee of Hanoi.



Note: - - - - Relationship in management; — Decentralization in management

In addition, two of the major lakes in Hanoi City, West Lake and Hoan Kiem Lake, have their own lake management boards.

The organizational structure of the lake management apparatus in the Urban Center of Hanoi City is mapped out as shown in Figure 1.16.

Figure 1.16. Regulating lake organizational structure and management of the Center Urban of Hanoi City

c. The organizational structure of the lake management of Hanoi

Drainage Company

Hanoi Drainage Company is responsible for the management and operation of the the regulating lakes system. Management work includes:

- Ensure the water level is safe to regulate rainwater during heavy rain;
- Operate the opening and closing of penstocks to regulate water flowing from lakes into the sewer system;
- Operating local pumping stations as well as major pumping stations to regulate rainwater when the rainfall exceeds the regulation capacity of lakes.

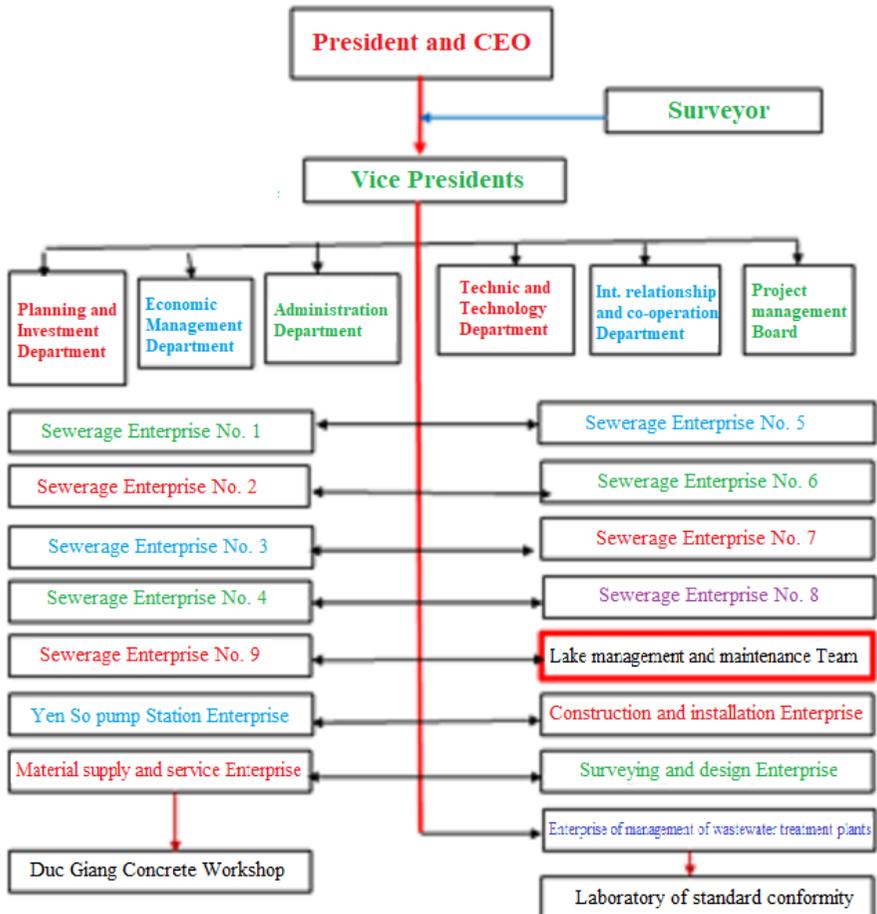


Figure 1.17. The organizational structure of the lake management of Hanoi Drainage Company

In addition, the company also undertakes other duties such as

monitoring the water quality of lakes, treating water pollution in lakes.... The company's organizational structure is shown in the diagram in Figure 1.17.

The unit that directly performs the maintenance and management of the regulating lakes is the Lake Maintenance Management Team under the Hanoi Drainage Company. The team has 148 people. The organizational structure of the company is shown in Figure 1.18.

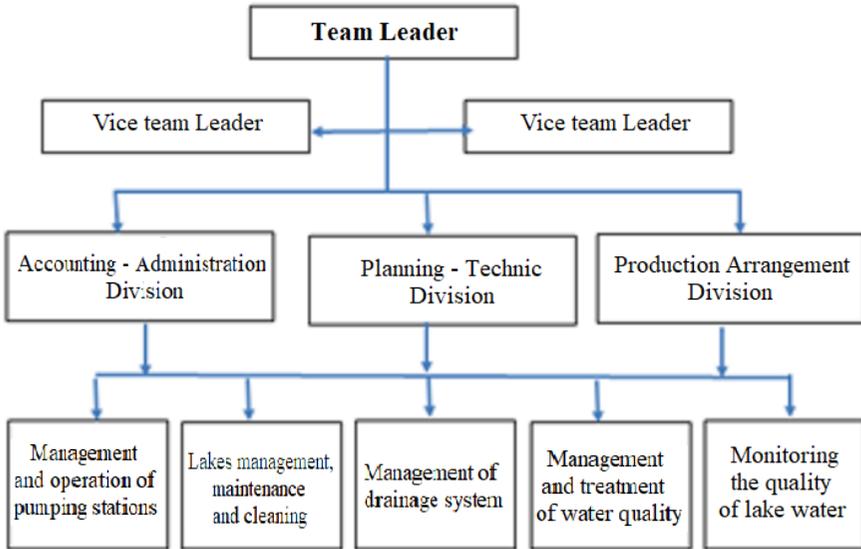


Figure 1.18. The organizational structure of the Lake Maintenance Management Teams under the Hanoi Drainage Company

1.4.5. Situation of socialization and community participation in the regulating lake management of the Urban Center of Hanoi City

Community activities involved in the management and protection of the regulating lakes in Hanoi are very diverse. These activities not only attract the participation of the people but also the participation of businesses, socio-political organizations.

1.4.6. Evaluation of the regulating lake management of the Urban Center of Hanoi City

- The management agencies of the central State as well as of Hanoi City have issued a lot of legal documents including laws, decisions, management regulations... to protect lakes and create a legal framework for better management of regulating lakes.

- In terms of State management, there are five specialized Departments that advise the City People's Committee on building mechanisms and policies to protect lakes. Each Department has different functions in the management of lakes.

- There are still a number of local authorities (wards and districts) that have not paid enough attention to the protection of the lakes.

- There is no single agency that consistently manages the regulating flow and regulation area of the lakes. These technical files are currently scattered in Departments, research institutes, companies, social organizations...

- Nhiều chủ thể quản lý trong cơ cấu tổ chức quản lý các hồ Đô thị Trung tâm thành phố Hà Nội gây nên sự chồng chéo trong quản lý

- The fact that there are many management entities in the organizational structure and management of lakes in the Urban Center of Hanoi City causes overlaps in management.

- The investment in the renovation and protection of regulating lakes is still in a “concentrated and subsidized state” that has not created the broad participation of the community of all economic sectors in society.

1.5. Overview of scientific works related to the thesis topic in Vietnam and in the world

1.5.1. Researches in Vietnam related to the management of regulating lakes

a. Doctoral thesis

The author of the thesis has synthesized 7 doctoral dissertations containing some contents related to the regulating lake management in the Urban Center of Hanoi City.

b. Scientific articles and researches

There have been 4 scientific articles containing contents related to the thesis topic up to now.

c. Books and workshop proceedings

The thesis has synthesized 4 documents, which are books and workshop proceedings, containing contents related to the management of regulating lakes.

1.5.2. Scientific researches on management of regulating lakes in the world

The thesis has synthesized 4 research works containing the content on regulating lake management for the purpose of regulating drainage for urban areas in some countries such as India, China, Russia...

1.6. General assessment of researched issues related to the thesis and existing issues that need more research to resolve

1.6.1. General assessment of researched issues related to the thesis topic

There have been 4 prominent problems in the management of regulating lakes:

- Situation of regulating lakes in the Urban Center of Hanoi City in terms of the role, cultural and historical values, landscape architecture, improving climatic conditions, environment, regulating rainwater, reducing inundation...

- Current status of lakes in terms of pollution, encroachment and leveling reduces the water surface area of lakes, reduces the ability to regulate climate, and regulate flow.

- Classification of lakes not only refers to the size, function, nature of creation... but also to the cultural factors, aesthetic value, landscape at different levels of each individual lake...

- Study management problems by approaching the multi-functional nature of regulating reservoirs in accordance with proper method of management, exploitation and use...

1.6.2. Existing issues that need more research to resolve

- Identify, identify and classify research subjects for regulating lakes within the limits of rainwater regulation, minimizing urban inundation .

- Define the scope of management in terms of the boundaries of each lake in the urban area.

- Classification of lakes. Identify the basic functions of the lakes. On the basis of this classification, determine the scope of management of the regulating lakes in terms of boundaries to serve as a basis for storing technical management documents for each regulating lake.

- Determine the ratio of the water surface area at each level of enforcement compared with the regulations in the planning project, propose scatter planning solutions and the number of documents needed to be built for each area.

- Analysis of changes in watershed surface properties that reduce self-permeability and increase flows to lakes due to urbanization and climate change.

- Research on technical solutions to increase rainwater regulation capacity of regulating lakes and sustainable water drainage solutions.

- Determine requirements for the management of lakes, factors affecting the management of lakes (urbanization factors, climate change factors).

CHAPTER II: SCIENTIFIC BASIS FOR MANAGEMENT OF REGULATING LAKES TO REGULATE RAINWATER AND MINIMIZE INUNDATION IN THE URBAN CENTER OF HANOI CITY

2.1. Theoretical basis in the management of regulating lakes to regulate rainwater and minimize inundation in the urban area

2.1.1. Classification of regulating lakes and urban drainage systems

a. Classification of regulating lakes

Regulating lakes are classified according to the formation or the arrangement of lakes in the drainage system...

b. Classification of drainage systems

Urban drainage systems are classified as follows:

- *According to the function of conveying wastewater;*
- *According to the structures and construction conditions;*
- *According to the arrangement of the systems.*

2.1.2. Characteristics and role of regulating lakes in the drainage system

Characteristics and role of regulating lakes in the rainwater drainage system depends on the location and distribution in the basin and the ability to regulate rainwater...

2.1.3. Models of organization structures and determinants of the organization structures of regulating lakes

In general, there are 4 basic models of organization structures as follows:

- Line organization;
- Functional organization;
- Combinational organization (line and staff organization; linear - functional organization; target organization);
- Matrix organization.

2.1.4. Requirements in the management of regulating lakes

Ensure that the goals of the regulating lakes in the city are met. The requirements for coordination in management related to the exploitation, operation and management of the lakes as well as the participation of the community are ensured.

2.1.5. Socialization, community participation and supervision in regulating lake management of the drainage system

To maintain, renovate as well as the new construction of regulating lakes requires the participation of non-state economic sectors

2.1.6. Factors affecting the management of regulating reservoirs to regulate rainwater, minimize inundation in the Urban Center of Hanoi City

Factors affecting the management of regulating lakes include: natural conditions; social conditions; economic growth and urbanization; science and technology... These factors are mapped in Figure 2.12.

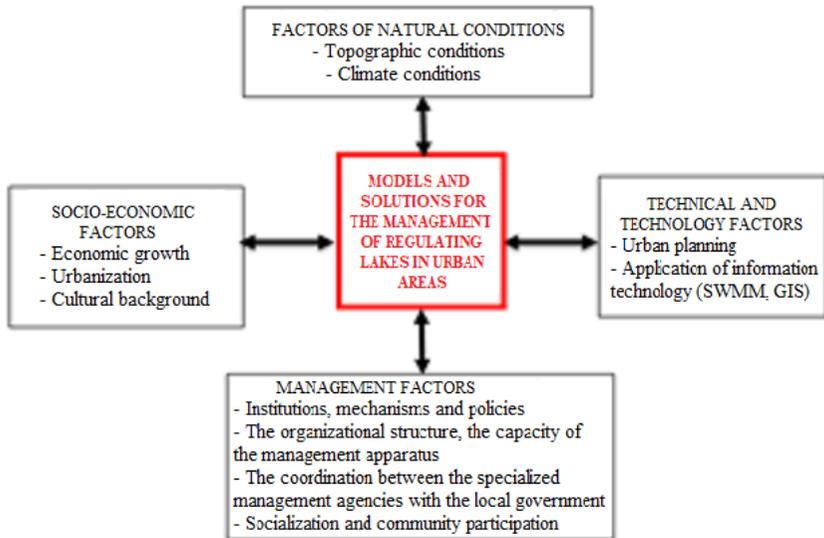


Figure 2.12. Diagram showing the factors affecting the management of regulating lakes

2.2. Legal basis for the management of reservoirs in the Urban Center of Hanoi City

2.2.1. Legal documents promulgated by central State agencies

There are many legal documents issued by central State management agencies related to the management of regulating lakes such as Laws, Decrees, Decisions, Circulars....

2.2.2. Documents issued by the People's Committee of Hanoi City

To manage the regulating lakes, Hanoi has issued many different documents and according to many development stages of the city.

2.2.3. Relevant standards and regulations

Regulations related to planning, technical regulations and standards such as Regulation 01: 2019 / BXD; QCVN 07: 2016...

2.2.4. Plans relating to drainage and regulating lakes

There are many planning projects related to the planning and management of regulating lakes in the Urban Center of Hanoi City, but the most important ones are 3 projects, whose contents are summarized below: General plan on capital construction up to 2030 with a vision to 2050;

General planning on drainage of Hanoi City to 2030 with a vision to 2050; Planning on the system of trees, parks, flower gardens and lakes in Hanoi City to 2030 with a vision to 2050.

2.2.5. Scenario on climate change in 2016 (projections for Hanoi City)

According to the Climate Change Scenario 2016, projections show changes in temperature, precipitation and other extreme climatic factors for Hanoi City.

2.3. Experience in managing regulating lakes to regulate rainwater and reduce urban inundation in Vietnam and around the world

2.3.1. Foreign experience

The author of the thesis has researched and outlined experiences in managing regulating lakes in London, England; experience in Bangkok, Thailand and the experience of Fukuoka city, Japan

2.3.2. Domestic experience in regulating lakes to regulate rainwater and minimize urban inundation

The thesis presents experience in managing regulating lakes in Hai Duong city.

CHƯƠNG III: PROPOSE MODELS AND SOLUTIONS OF REGULATING LAKE MANAGEMENT FOR REGULATING RAINWATER AND MINIMIZING INUNDATION IN THE URBAN CENTER OF HANOI CITY

3.1. Viewpoints, objectives and principles of management of the regulating lakes in the Urban Center of Hanoi City

3.1.1. Viewpoint for regulating lakes

- Management of regulating lakes is to manage drainage according to natural conditions and take advantage of the advantages that Hanoi has.

- Management of regulating lakes must be seen as managing a "soft" building against flooding in the city, responding to weather uncertainties as well as responding to future development forecasts.

- An investment in regulating lakes is an investment in an asset. Therefore, it will be necessary to take into account both the direct and indirect benefits that the reservoirs will bring.

- The organizational structure of regulating lakes management must be uniform and uniform in all management levels and stages .

3.1.2. Objectives and requirements for the management of regulating lakes

a. Objectives:

- Protect existing values and respond effectively to the impacts of development, urbanization and global climate change.

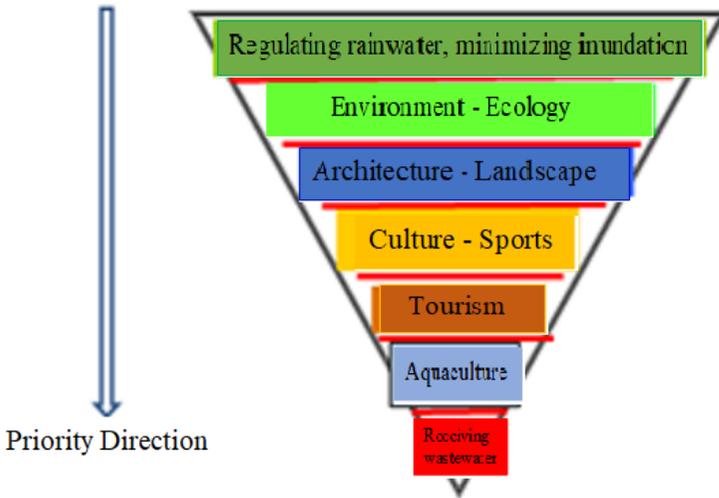
- Increase the use value of each lake.
- Determine priority targets in management, investment, construction and embellishment of regulating lakes.
- The policy mechanism, the compact organizational structure ensures the coordination in management.

b. Requirements:

The thesis proposes 6 requirements in the management of regulating lakes, including: Full implementation of the provisions of the law; compliance with planning projects related to regulating lakes; integrating software in management and operation; harmonious management of the functions of lakes; have a uniform policy mechanism and management apparatus; promote socialization and community participation...

3.1.3. Principles of regulating lake management

Principles of management of regulating lakes are summarized as shown in the following Diagram 3.1:



*Figure 3.1.
Diagram
of priority
order of
managem
ent goals
for regulat
ing lakes*

3.2. Proposing solutions to adjust the layout planning of regulating lakes in the Urban Center of Hanoi City

3.2.1. Solution of planning adjustment in the direction of dispersing regulating lakes for each drainage basin

solutions to enhance the construction of new regulating lakes according to basins to achieve the level of water surface that accounts for about 5% of the catchment area, but is distributed to the basins.

Table 3.1. Proposed surface area of lakes and number of lakes in each basin in the Urban Center of Hanoi City

Basin	Yen So basin	Basin in the west of Hanoi	Dong My basin	Ba Vi basin	Khe Tang basin	Ta Thanh Oai basin	Thach Nhan basin
The total area of the new lakes	22.8	306.57	26.83	57.7	60.48	14.25	24.6
Number of new proposed lakes	03	12	03	04	03	02	02
Proportion to the basin	5.0	5.0	5.0	5.0	5.0	50	50

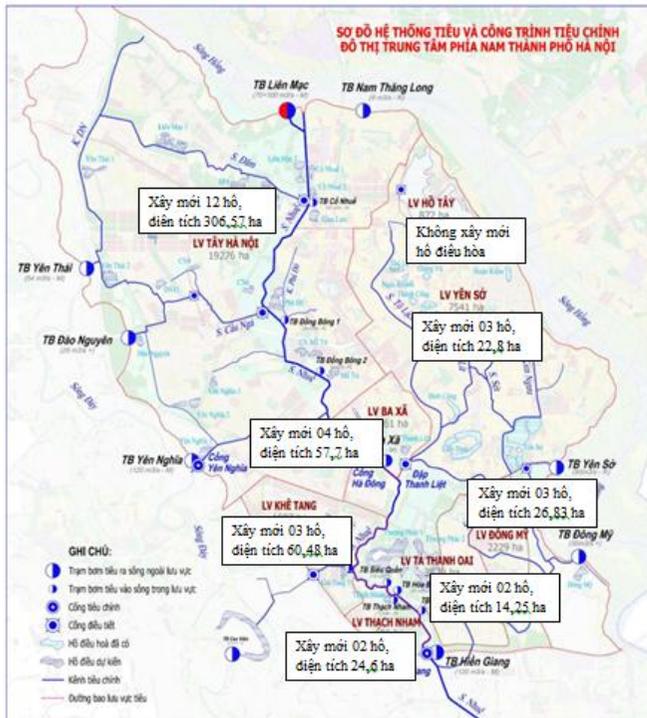


Figure 3.2. Proposed layout for the construction of new regulating lakes in some basins of the Urban Center of Hanoi City

In terms of management, the scatter planning of regulating lakes has the following basic advantages:

- Step by step investing according to the priority schedule (heavy and frequent flooded

areas; areas with high construction density...);

- Adapt to factors of predictive uncertainty;
- Combine damage mitigation solutions with risk reduction;

- Easily mobilize various resources, reduce the burden of State budget, promote community roles and responsibilities.

3.2.2. *Proposing criteria for the selection of the location of the regulating lakes and the connection with the urban drainage system*

3.3. Technical management solutions for regulating lakes to regulate rainwater and minimize inundation for the Urban Center of Hanoi City

3.3.1. *Solution to increase the regulating capacity of regulating lakes, support rainwater regulation to minimize flooding in the Urban Center of Hanoi City*

Proposing the construction of new regulating lakes to ensure the conditions specified in the planning project and legal documents (rate of water surface, rainwater reuse, sustainable drainage...).

The content of this solution is to renovate areas adjacent to lakes (paths around lakes, trees, flower gardens around lakes ...) into water-permeable areas, keeping water in case of rain; increasing the regulating capacity of the watches while retaining some of the rainwater in the lakes for reuse.

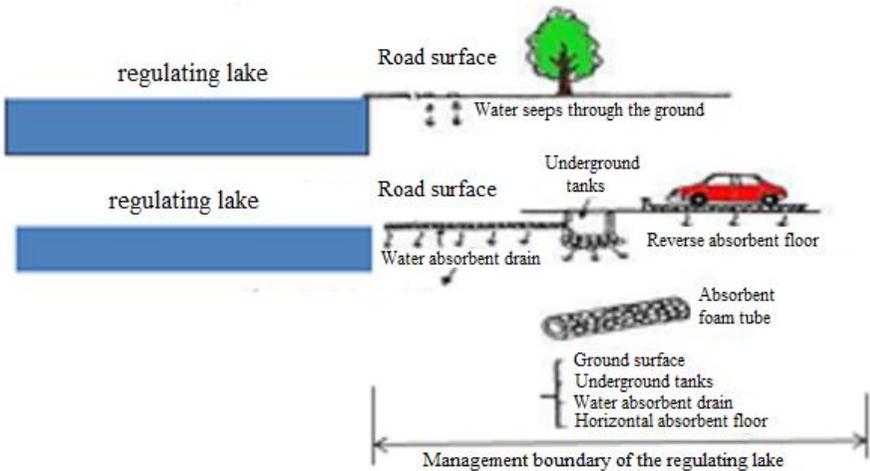


Figure 3.3. Diagram illustrating the proposed surface improvement under the management of structural reservoirs, self-absorbing materials and underground water storage tanks

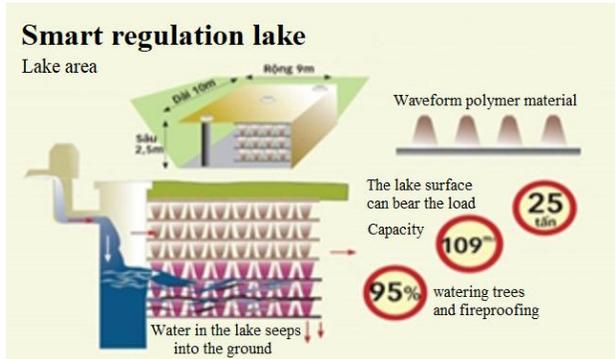
Solution of using permeable pavement structures and permeable ditches are drainage solution that is completely suitable for the construction site conditions within the management boundary of the regulating lakes. The aforementioned structure is currently produced in many cities in Vietnam .

3.3.2. Solutions for constructing smart regulating lakes and underground tanks containing rainwater

Solutions for smart regulating lakes and underground rainwater tanks are proposed for all narrow areas in the inner city of Hanoi, especially in areas with frequent local inundation when it rains.

a. Application solutions for intelligent conditioning lakes

Figure 3.7. Diagram illustrating proposal of intelligent rainwater conditioning lakes



b. Solution for using underground tanks containing rainwater

It is proposed to build underground water drainage tanks to minimize flooding caused by rain and make use of rainwater for the urban area (watering trees, washing roads, preventing fire...).

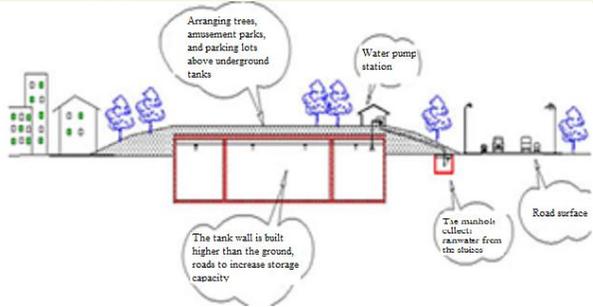
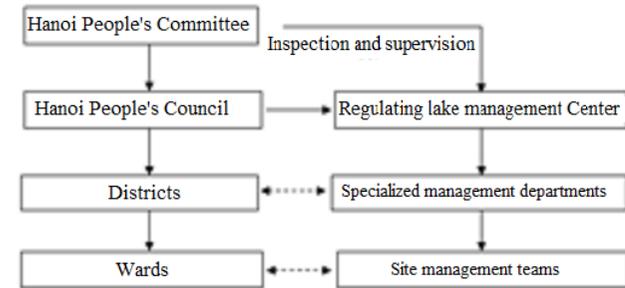


Figure 3.8. Diagram illustrating the proposal of a rainwater tank to prevent urban inundation and to reuse rainwater

3.4. Proposing organizational model for the management of regulating lakes in the Urban Center of Hanoi City

3.4.1. It is proposed to establish the Management Center for regulating lakes, directly under the People's Committee of Hanoi City



Note
 → Management decentralization relationship
 ←······ Relationship management coordination

regulating lakes, directly under the People's Committee of Hanoi City

Figure 3.9. Proposed diagram of the decentralized relationship

and coordination in the organizational structure of the Management Center for regulating lakes with the People's Committee of Hanoi City

3.4.1.1. Organizational structure of the Management Center for regulating lakes of Hanoi City

a. Functions of the Management Center for regulating lakes

The Center has 11 functions:

Manage technical infrastructure works within the management boundary of regulating lakes;
 Management and licensing of cultural activities, arts, sports, commercial activities and tourism services...; manage the conservation of heritages related to the regulating lakes, the surrounding architectural - landscape works; coordinating with local authorities to manage security and order, motorbike parking, and services; water level management of lakes, operation of regulating pump stations, operation of sluices, drainage routes around lakes; water quality management in lakes...

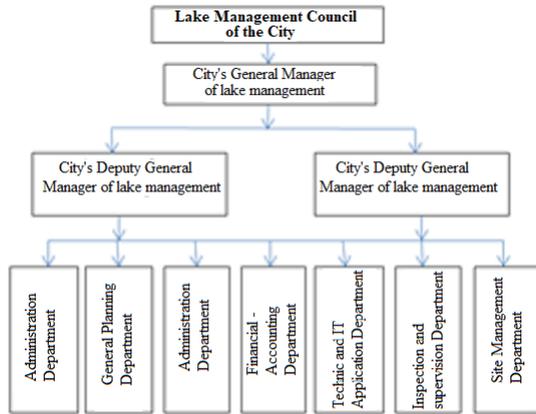


Figure 3.10. Diagram of organizational structure of regulating lake management

b. The duties of the Management Center for regulating lakes

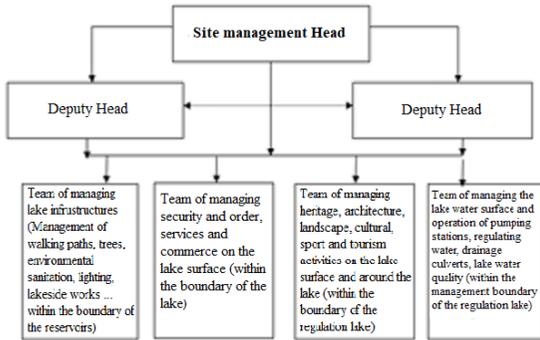
Including 8 tasks: Being the focal point to manage and store all documents related to the air conditioning lakes; investing in works of renovation, renovation or new construction of regulating lakes; make technical connections; arranging entertainment facilities, services, commerce, advertisement billboards... on the surface of lakes and on the shore within the management boundary of the lakes...

c. Human resources:

The Center's human resources are mainly recruited and transferred from units that are directly performing these tasks in departments, departments as well as workers and technical staff of companies such as the Company. Environment Company, Sewerage Company, Green Park Company ... of the City as well as at all levels of local authorities.

d. Proposal on functions and tasks of the units directly under the Management Center for regulating lakes

Including the following departments: Department of Organization - Administration; Department of General Administration and Planning; Financial Accounting Department; Department of Information Technology and Application; Inspection Department; Local management Department.



Hình 3.11. Diagram of organizational structure Local management Department under the Management Center for regulating lakes

Local management Department: Local management departments are established according to the respective administrative units at district level: Ba Dinh district, Dong Da district, Hai Ba Trung district, Hoan Kiem district, Hoang Mai district, Ha Dong district, , Bac Tu Liem district, Nam Tu Liem district, Long Bien district... Local management department is shown in Figure 3.11.

3.4.1.2. The collaborative working relationship between the Local management Department and other departments



Figure 3.12. Diagram of the collaborative working relationship between the Local management Department and other departments of the Hanoi People's Committee

The collaborative working relationship between the Local management Department and other departments is shown in Figure 3.12 .

Model of organizational structure of the Management Center for regulating lakes in the administrative organizational structure of Hanoi City is shown in Figure 3.13.

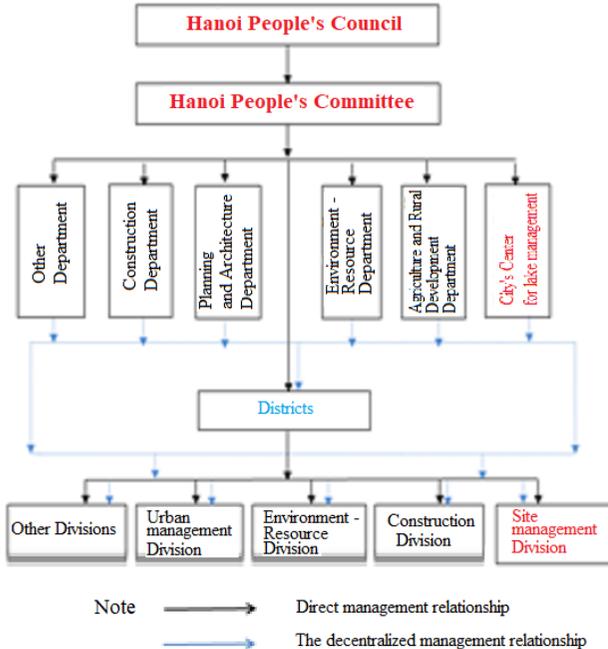
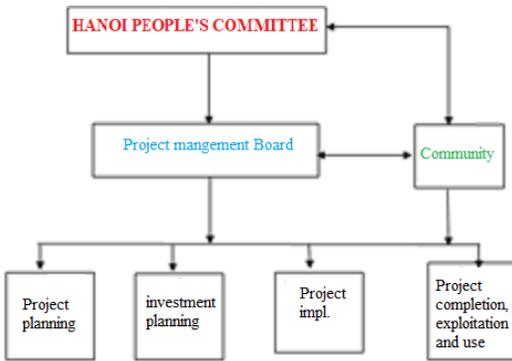


Figure 3.13. Diagram of organizational structure of the Management Center for regulating lakes in the administrative organizational structure of Hanoi City.

3.4.2. Proposing mechanisms and policies in the management of regulating lakes

The proposals include: Investment in new construction of regulating lakes; diversify capital sources and investment forms; choose the method of investment; prioritize and encourage self-management activities; preferential treatment and support for projects on pollution treatment and water purification in lakes...

3.4.3. Proposing solutions to mobilize community participation in the management and operation of lakes and works within the management boundary of regulating lakes



Including: Content and requirements of advocacy work; mode of carrying out activities; education to raise awareness of the community; community participation stages;

Figure 3.14. Diagram of community participation process in lake management in the Urban Center of Hanoi

City

Establish a Community Investment Supervision Board;

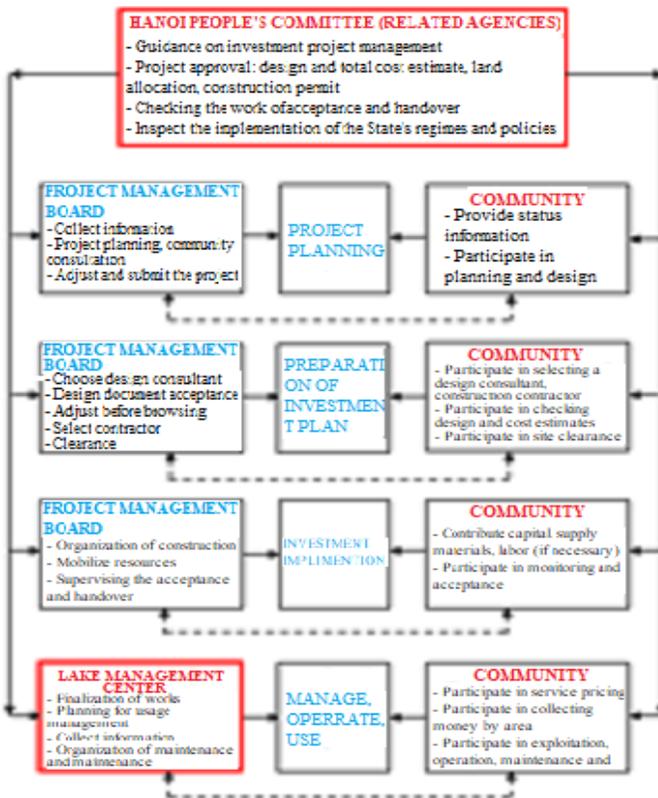


Figure 3.15. Diagram of community participation process in monitoring investment projects of lake construction

Note ←----- Management coordination relationship
 →----- Direct management relationship

The establishment of the Community Investment Supervision Board is based on the 2019 Law on Public Investment (Articles 74 and 75), Article 51 of Decree 84/2015 / ND-CP regulating the organization of community investment supervision and Decree 01/2020 / ND-CP dated January 1, 2020 on amending a number of articles of Decree 80/2015 / ND-CP; organize training courses to raise awareness for the community in ensuring the harmonization of functions of regulating lakes in exploitation and use.

3.5. Discuss the research results

3.5.1. The feasibility of proposing to adjust the planning in the direction of distributing regulating lakes according to each drainage basin

Planning adjustment towards the dispersion of the number of regulating lakes in the rainwater-regulating basin will increase the rainwater regulation efficiency. At the same time, it also facilitates investment decentralization in order of priority, not concentrating investment in one package because it will cause economic burdens.

3.5.2. Feasibility of technical solutions group

First of all, the current advances in science, technology and technology allow us to carry out technical measures in the management of lakes as suggested by the thesis, including: rehabilitation of the area adjacent to lakes into a self-absorbing area, building water tanks, building smart water tanks to reuse rainwater

3.5.3. Discussion about the proposed organizational structure for the management of regulating lakes of the Urban Center of Hanoi City

Proposing to establish the Management Center for regulating lakes which is directly under the People's Committee of Hanoi City to unify the focal point for the management of regulating lakes in the city; building a management coordination mechanism, ending current overlapping management in accordance with current documents (Decision No. 725/2013/QĐ-TTg of the Prime Minister on approving the drainage plan for Hanoi Capital to 2030 with a vision to 2050).

3.5.4. Discussion on proposing mechanisms and policies for regulating lake management

Proposed mechanisms and policies will create favorable conditions for the socialization of investment capital, in accordance with current legal documents.

3.5.5. Proposal for community participation in management of regulating lakes

In many areas of management, including management of regulating lakes, a key factor to success is community participation. However, for the participation of the community, it is necessary to have many solutions, many

modes of action, including the establishment of the Community Investment Supervision Board.

CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

The master plan on building Hanoi Capital to 2030 with a vision to 2050 has determined that the Center Urban of Hanoi City has an area of about 756 km². In the Center Urban of Hanoi City, there are about 2,625 natural and artificial lakes, of which there are 122 lakes in 12 urban districts and 2,503 lakes distributed in 18 districts and Son Tay Town.

Through investigation, survey and data collection, analysis and assessment of the current status of the management of regulating lakes in the Center Urban of Hanoi City as well as based on scientific basis in the management of regulating lakes, the thesis proposes the following management solutions and models:

- Planning adjustment in the direction of evenly dispersing the number of newly built regulation lakes over the entire area of each drainage basin to ensure the minimum conditions of rainwater flow to the lakes, minimizing the street inundation, at the same time maximizing the efficiency of the ecological environment;

- Solution to renovate and build the area adjacent to the lakes (within the management boundary of the lakes) into a self-absorbing area, storing rainwater, supporting the regulation capacity of the lakes, coping with increase in stormwater runoff due to urbanization and climate change;

- Solution of building smart regulating lakes, water tanks in inner-city areas where there is high construction density, narrow area to solve the problem of local inundation and reuse rainwater for different uses in the city;

- Establishing the Management Center for regulating lakes under the People's Committee of Hanoi City to unify the focal point for management and improve management efficiency in coordination and management coordination with relevant departments and agencies.

- Proposing mechanisms and policies for regulating lake management in the Center Urban of Hanoi City;

- Proposing on socialization, community participation in the management of regulating lakes to increase the ability to regulate, minimize inundation, and promote well other functions of the lakes .

2. Recommendations

In order for the research results and the proposed contents of the thesis to become a reality soon, the author would like to give the following recommendations:

a. For the People's Committee of Hanoi City

- It is necessary to soon establish management boundaries as well as data and data of each regulating lake in the Center Urban of Hanoi City;

- Establish a legal basis, develop a project to establish the Management Center for regulating lakes and soon operate this Center.

- Study, draft and promulgate the Regulation on the regulating lake management in the Center Urban of Hanoi City and guiding documents on socialization of investment as well as community participation in the management of regulating lake in the Center Urban of Hanoi City.

b. For specialized management agencies:

- Specialized agencies continue to study the use of self-absorbing materials, permeable concrete for sustainable drainage system.

- Continuing to study to determine the location of building smart regulating lakes and water tanks in the Center Urban of Hanoi City. At the same time, Hanoi also conducts structural design of rainwater reservoirs and treatment solutions to reuse rainwater for urban consumption purposes.

AUTHOR'S SCIENCE WORKS RELATED TO THE STUDY OF THE THESIS

1. Chu Manh Ha (2017): Urban lakes and the role of rainwater regulation in urban drainage systems, published in the Journal of Architecture and Construction, Hanoi Architectural University, No. 28-102017; ISSN 1859 - 350X.

2. Chu Manh Ha (2018): Scientific article: Management of urban lakes for rainwater drainage regulation - Current situation and solutions published, in the Journal of Architecture and Construction, Hanoi Architectural University, No. 30 - 5.2018; ISSN 1859 – 350X.

3. Chu Manh Ha (2019): Good management of urban lakes is an important factor in improving the environmental landscape and minimizing urban inundation, published in the Journal of Environment and Urban - Vietnam Association of Urban Environment and Industrial Zones, No. 123/2019 [new Vol.] ISSN: 1859 – 3674.

4. Chu Manh Ha (2019): The role of regulating lakes in regulating rainwater, minimizing inundation in the Center Urban of Hanoi City published in the Journal of Environment and Urban - Vietnam Association of Urban Environment and Industrial Zones, No. 35 – 36/2019; ISSN 1859-3658.

5. Chu Manh Ha (2020): Research on solutions to dispersing planning of regulating lakes and using smart regulating lakes to minimize local inundation and reuse rainwater in the Center Urban of Hanoi City, published in the Journal of Environment and Urban, number: 136 + 137 (November + December 2020); ISSN: 1859 – 36.