

완충저류시설 설계 시 고려사항 분석을 통한 합리적 항목 제시

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Suggestion the Rational Items with Comparison and Review for Designing of Buffering Retention Facility

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요약

유독성 물질로 인한 환경오염사고 방지 및 수환경 보호를 위해 정부에서는 완충저류시설의 설치를 제도적으로 추진하고 있다. 완충저류시설은 사고유출수 및 초기우수를 저류하여 수질오염을 방지하는 긍정적인 역할에도 불구하고 관련연구 및 시설의 설계를 위한 구체적인 가이드 라인은 부족한 실정이다. 본 연구에서는 완충저류시설 설계 도서를 분석하여 어떠한 항목을 설계에 반영하였는지 분석하였다. 분석결과를 바탕으로 설계항목을 도출하고, 완충저류시설 관계자의 의견을 반영하여 완충저류시설의 설계에 필요한 항목을 제안하였다.

핵심용어: 완충저류시설, 설계, 항목

ABSTRACT

Korea Government promotes the installation of buffering retention facility to protect the water environment and prevent the environmental contamination event by toxic materials. Although the buffering retention facility is very important to protect the natural environment through the retention of accidental pollution and initial runoff, much study has not been done to suggest the guide line for the design of the facility. In this study, we suggested the rational items for the design of buffering retention facility based on many experts after we investigated and compared the previous results of many design materials.

Keywords: Buffering Retention Facility, Design, Item

1. 서론

환경오염에 대한 대중적인 관심은 지속되고 있으며, 정부에서도 환경오염을 방지하기 위한 노력을 해오고 있다. 특히 유독화학물질 등이 하천에 유입될 경우 환경재난의 위험을 가중하게 된다. 1991년 낙동강 페놀 오염 사고를 계기로 정부에서

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Received: 18 January 2022, Revised: 18 March 2022, Accepted: 21 March 2022



는 낙동강수계 물관리 종합대책과 낙동강수계 물관리 및 주민지원 등에 관한 법률을 제정하여 수질유해물질로 인한 수자원 오염 등의 환경재난을 저감하기 위해 완충저류시설의 설치를 도입하였다. 완충저류시설은 공업지역 또는 산업지역 내 사고 및 화재 등으로 인한 사고 유출수 및 초기우수를 저류하는 시설(환경부 예규 제665호)로 물환경보전법 시행규칙에서 설치 대상을 정하고 있다. 현재 완충저류시설은 관련법·제도가 제정된 이후 지속적으로 건설되고 있으나, 완충저류시설 설계와 관련된 연구사례는 부족한 실정이다. 또한, 설계도서 구성을 위한 구체적인 가이드라인이 부족한 상황으로 설계자의 사업수행경험과 식견에 의지하여 설계도서를 작성하고 있어 설계자의 역량에 따라 설계 성과의 품질차이가 발생하는 우려가 높은 상황이다. 이러한 제도적 미흡함을 보완하고 좀 더 체계적인 설계 기반을 마련하고자 본 연구에서는 완충저류시설의 설계항목을 검토하고, 설계도서 작성에 필요한 세부항목을 제안하는 것을 목적으로 하였다.

2. 본 론

2.1 현황분석

완충저류시설의 현황분석은 국내의 완충저류시설 설계 도서를 수집하고, 각각의 완충저류시설 설계과정에서 포함된 설계 항목을 도출하였다. 도출된 항목을 비교 및 검토하여 설계과정에서 불필요한 부분과 중복된 부분을 제거하여 완충저류시설 설계항목을 제안하였다.

완충저류시설 현황분석에 사용된 설계도서는 기본설계 및 실시설계 자료를 수집하여 분석하였다. 자료수집 기간은 완충저류시설이 본격적으로 설치되기 시작한 2004년부터 가장 최근인 2020년까지 설계가 완료된 자료를 수집대상으로 선정하였다. 주요 조사 문헌은 다음 Table 1에 수록하였다.

Table 1. Main literature of design documents

No.	Name	Author	Year
Case01	Basic & Working Plan of Buffering Retention Facility for Ochang Scientific Industrial Complex at Cheongju	Cheongju-City, Korea Environment Corporation	2020
Case02	Basic & Working Plan of Buffering Retention Facility for Jinwi 3 rd Industrial Complex at Pyeongtaek-si	Jinwi 3 rd Industrial Complex	2017
Case03	Basic & Working Plan of Buffering Retention Facility for MegaPolis at Chungju	Chungju-city	2016
Case04	Basic & Working Plan of Buffering Retention Facility for Goryeong Dasan Industrial Complex in Nakdong River Basin	Korea Environment Corporation	2014
Case05	Basic & Working Plan of Buffering Retention Facility for Kimcheon Industrial Complex in Nakdong River Basin	Korea Environment Corporation	2013
Case06	Basic & Working Plan of Buffering Retention Facility for Waegwan 1&2 and Yeongcheon Donam Industrial Complex in Nakdong River Basin	Korea Environment Corporation	2012
Case07	Basic & Working Plan of Buffering Retention Facility for Chaesin 1 st Industrial Complex	Korea Environment Corporation	2011
Case08	Basic & Working Plan of Buffering Retention Facility for Gyeongsan 2 nd (Jain) Industrial Complex	Korea Environment Corporation	2011
Case09	Basic & Working Plan of Buffering Retention Facility for Gyeongsan 1 st (Jillyang) Industrial Complex	Korea Environment Corporation	2009
Case10	Basic & Working Plan of Buffering Retention Facility for Dalseong Industrial Complex at Daegu	Environmental Management Corporation	2004

수집된 자료의 분석을 위해 각 시설의 설계과정에서 적용한 설계항목을 도출하여 분석하였다. 완충저류시설의 설계와 관련된 항목은 크게 기초조사와 관련 분야, 기본설계 분야, 실시설계 분야로 구분되었다. 조사 분야는 지역 현황조사, 관련계획 조사 등의 기초조사와 측량, 지반조사 등의 현장조사로 구분되며, 세부항목을 나열하고 항목의 중복성 검토를 실시하여 분석한 결과 총 118개 항목이 도출되었다. 기초조사와 관련된 주요 항목을 살펴보면 지역의 일반현황 조사, 사회적 특성조사, 산업단지 현황조사, 배수구역 및 기존 관거 현황 조사, 연계처리시설 현황조사, 폐수종말처리시설 현황조사, 비점오염저감시설, 환경기초시설 현황, 환경관련 지역현황, 상수도시설 현황, 문화재 및 고적 등 기타 자료 조사, 상위계획 및 관련계획 조사, 관련법규 및 지침 검토, 완충저류시설 설치사례 조사 등으로 구분되었다. 현장조사와 관련된 주요 항목은 측량조사, 지반(토질)조사, 유량 및 수질조사, GPR(Ground Penetrating Radar) 탐사 조사로 구분되었다.

기본설계와 관련된 항목은 총 80개가 있는 것으로 분석되었다. 주요 항목으로는 위치선정, 저류대상구역 설정, 저류대상물질 검토, 완충저류시설 용량 설정, 완충저류시설 목표 처리 효율, 완충저류시설 단위공정 계획, 저류대상물질 차집계획, 유입수 수질모니터링, 저류대상물질 저류계획, 완충저류수의 수질검사, 완충저류수의 처리로 분석되었다. 기본설계와 관련하여 도출된 항목을 위해 활용한 설계도서별 항목별 비교는 다음 Table 2에 수록하였다.

Table 2. Comparative analysis of basic design items

Item of Basic Design	Case 01	Case 02	Case 03	Case 04	Case 05	Case 06	Case 07	Case 08	Case 09	Case 10
Determination of Location	○	○	○	○	○	○	○	○	○	○
- Basic Direction	○	○	○	○	○	○	○	○	○	
- Regional Status of Target Site	○	○	○	○	○	○	○	○	○	
- Comparison of Target Sites	○		○	○				○	○	
- Review of Target Site				○		○	○	○		
- Selection of Target Site					○					
- Consideration of Transfer Site					○				○	
- Review of License				○						
Setting of Retention Area	○	○	○	○	○	○	○	○	○	○
- Installation Purpose & Related Laws	○	○	○	○	○	○	○	○		
- Retention Area	○	○	○	○	○	○	○	○		○
Review of Retention Materials	○	○	○	○	○	○	○	○	○	
- Review of Related Plans and Laws	○			○	○	○	○	○	○	
- Basic Direction		○	○							
- Selection of Retention Materials	○	○	○	○	○	○	○	○	○	○
- Review Results		○	○							
Setting of Capacity for Buffering Retention Facility	○	○	○	○	○	○	○	○	○	○
- Basic Direction		○								
- Related Laws & Plans				○	○	○	○	○	○	
- Review of Installation Method	○									
- Study on Application of Existing Facility (Retention Facility of Non-point Pollution)	○									
- Selection of Installation Type	○									
- Review of Existing Cases					○	○	○			
- Estimation of Accident Spill		○	○		○					

Table 2. Comparative analysis of basic design items (continued)

Item of Basic Design	Case 01	Case 02	Case 03	Case 04	Case 05	Case 06	Case 07	Case 08	Case 09	Case 10
- Estimation of Fighting Water		○	○							
- Estimation of Base Flow rate for Storm Sewer Pipe		○	○		○	○				
- Determination of Buffering Retention Facility	○	○	○	○	○	○		○	○	○
- Modeling(Review of Retention Effect based on Rainfall-Runoff Model)				○	○	○	○	○	○	○
Objective Treatment Efficiency of Buffering Retention Facility				○						
- Review of Discharge and Linked-Processing with Existing Retention Facility				○						
- Review of Objective Treatment Efficiency for Non-Point Pollution Retention Facility				○						
- Water Quality Standard for Simple Processing Exceeding Facility Capacity of Public Sewage Treatment Plant Processes during Rainfall Event				○						
- Review of Management Water Quality for Combined Sewage Overflows (CSOs)				○						
- Determination of Objective Treatment Efficiency for Buffering Retention Facility				○						
Unit Process Plan of Buffering Retention Facility	○	○	○	○	○	○	○	○	○	○
- Unit Operation and Process Plan	○							○	○	
- Review of Monitoring Device for Hazardous Material	○							○	○	
- Intercepted Stage of Retention Material		○	○		○	○	○			
- Stage of Water Quality Monitoring	○	○	○		○	○	○			
- Retention Stage of Retention Material		○	○		○	○	○			
- Measurement Stage of Water Quality of Buffering Retention Water		○	○		○	○	○			
- Treatment Stage of Buffering Retention Water					○	○	○			
- Treatment Stage of Deposit of Buffering Retention Facility		○	○		○	○	○			
Intercepted Plan of Retention Material	○	○	○	○	○	○	○	○	○	
- Current Status of Storm Sewage Pipe (Current Status of Drainage Area)	○	○	○	○	○	○	○	○	○	
- Intercepted Plan		○	○		○				○	
- Plan of Intercepted Pipe	○			○	○	○	○	○	○	○

Table 2. Comparative analysis of basic design items (continued)

Item of Basic Design	Case 01	Case 02	Case 03	Case 04	Case 05	Case 06	Case 07	Case 08	Case 09	Case 10
- Review of Intercepted Facility (Movable Weir)	○									
- Review of Mountain Valley Inflow Exclusion and Intercepted Plan					○					
Water Quality Monitoring of Inflow		○	○	○		○	○			○
- Basic Direction		○	○	○						
- Installation Basis of Water Quality Monitoring for Inflow		○	○	○						
- Application Case of Buffering Retention Facility		○	○	○						
- Review of Monitoring Device for General Item		○	○	○	○	○	○			
- Review of Monitoring Device for Hazardous Material		○	○	○	○	○	○			
- Determination of Monitoring Facility for Inflow		○	○	○						
Retention Plan for Retention Material		○	○	○	○	○	○			
- Basic Direction		○	○							
- Retention Plan for Clear Day				○						
- Retention Plan for Rainy Day				○						
- Retention Plan for Accident Spill		○	○	○		○				
- Separation Retention Plan based on Water Quality of Inflow		○	○	○						
- Facility Plan				○						
Water Quality Test for Buffering Retention Water	○	○	○	○	○	○	○	○		
- Purpose of Water Quality Test	○	○	○	○						
- Period of Sample Collection for Water Quality Analysis	○	○	○	○						
- Location of Sample Collection of Buffering Retention Water for Water Quality Analysis	○	○	○	○	○					
- Item of Water Quality Test	○	○	○	○	○	○	○			
- Executing Organization of Water Quality Test	○	○	○	○	○	○	○			
Treatment of Buffering Retention Water	○	○	○	○	○	○		○	○	
- (Initial Stage) Treatment of Rainfall Runoff				○						○
- Treatment Concept of Accident Spill		○	○	○						
- Investigation of Retention and Treatment Record of Accident Spill at Similar Facility	○	○	○		○					
- Review of Treatment Method of Accident Spill	○	○	○	○	○				○	

Table 3. Comparative analysis of working design items (continued)

Working Plan Item	Case 01	Case 02	Case 03	Case 04	Case 05	Case 06	Case 07	Case 08	Case 09	Case 10
Review of Structure Foundation		○	○							
- Review Object and Outline		○								
- Determination of Foundation Type		○								
- Application State of Foundation Type		○								
- Review of Safety for Direct Foundation		○								
- Review of Excavation Method		○								
Review of Slope Stability		○	○							
- Outline		○								
- Method of Soil Slope Analysis		○								
- Applied Groundwater Level		○								
- Review of Safety Ratio of Slope		○								
- Result of Slope Stability Analysis		○								
- Structure Waterproof Type Plan		○								
Architecture Field			○	○	○	○	○	○	○	
- Outline of Construction Work				○	○	○	○	○	○	
- Concept of Architecture Plan				○	○	○	○	○	○	
- Architecture Plan			○	○	○	○	○	○	○	
- Main Material Plan				○	○	○	○	○	○	
- Structure Plan			○	○	○	○	○	○	○	
- Machine Equipment Plan			○	○	○	○	○	○	○	
- Detention Tank Ventilation Plan									○	○
Mechanical Field	○	○	○	○	○	○	○	○	○	
- Basic Direction	○	○	○	○	○	○	○	○	○	
- Design Condition	○	○	○	○		○	○	○		
- Treatment Process Chart of Buffering Retention Facility				○		○	○	○		
- Comparison of Process Plan and Main Device per Unit Equipment	○	○	○	○	○	○	○	○	○	
- Mechanical Equipment List	○	○	○							
- Instrument Diagram) Treatment Schematic Diagram (Piping and Instrument Diagram)		○	○	○	○	○	○	○	○	
Electricity & Instrument and Control Field	○		○	○	○	○	○	○	○	○
- Project Outline		○	○	○	○	○	○	○	○	
- Project Range		○	○	○	○	○	○	○	○	
- Plan Direction and Principal Point		○	○	○	○	○	○	○	○	
- Related Laws and Standard		○	○	○						
- Electric Equipment	○	○	○	○	○	○	○	○	○	○
- Instrument and Control Equipment	○			○		○	○	○	○	○
- Architecture Electric Equipment		○	○	○	○	○	○	○	○	
- Disaster Prevention Equipment		○	○							

Table 3. Comparative analysis of working design items (continued)

Working Plan Item	Case 01	Case 02	Case 03	Case 04	Case 05	Case 06	Case 07	Case 08	Case 09	Case 10
- Low Carbon Green Growth Plan (Energy Saving Plan)		○	○	○	○	○	○	○	○	
Instrument and Control Plan		○	○							
- Outline		○	○							
- Plan Direction and Principal Point		○	○							
- Project Range		○	○							
- Related Laws and Standard		○	○							
- Monitoring Control Equipment		○	○							
- Remote Monitoring Control Equipment		○	○							
- Instrument Equipment		○	○							
- Uninterrupted Power Supply Equipment		○	○							
Landscaping Field	○		○	○	○	○	○	○	○	○
- Basic Direction	○		○	○	○	○	○	○	○	
- Current Status Investigation and Analysis			○							
- Plan Content			○		○					
- Concept of Main Planting	○									
- Determination of Applied Species of Trees	○									
- Planting Plan	○			○	○	○	○	○	○	
- Planting Planning Map	○									
- Facility Plan				○	○	○	○	○	○	
- Pavement Plan				○	○	○	○	○	○	

2.2 설계도서 구성 항목의 제안

2014년부터 2020년까지 완충저류시설 설계도서를 검토하여 설계에 적용된 항목을 비교·검토하였다. 완충저류시설 설계도서를 검토한 결과 유사한 입지와 규모의 시설에서도 설계를 위해 검토하는 항목의 차이가 있는 것으로 분석되었다. 이러한 설계도서간 구성항목의 차이는 완충저류시설 설치를 위한 구체적인 지침의 제시가 부족한 것이 원인으로 보이며, 사업의 유사성에도 불구하고 구체적인 기준이 부족할 경우 일반적으로 검토해야 하는 사항이 누락될 수도 있다는 것을 보여주었다. 예를 들어 보면 완충저류시설을 계획할 때 어떤 물질을 저류할 것인지 저류대상물질을 검토해야 한다. 저류대상물질은 청천시, 강우시, 사고유출수 발생시 등의 저류계획을 수립하여 사업계획을 수립하여야 하나, 조사된 사업 중에 이러한 사항을 일부 사업만이 구체적으로 제시하고 있어 관련사항을 정리하여 설계과정에서 누락이 없도록 제시하였다. 또한, 대상부지의 적정성 검토, 위치선정, 편입부지 검토 등과 같은 유사한 항목은 설치대상부지의 적정성 검토 항목으로 통합하였다. 완충저류시설의 설계과정에서 중요한 사항 중 하나는 저류시설의 용량 설정에 관한 것으로 기존의 설계과정에서는 유역 및 배수분구의 유출량 분석에 대한 구체적 제시가 부족하여 수리·수문학적 측면에서 용량 산정 결과의 검토에 다소 어려움이 있었다. 이러한 문제점을 개선하기 위하여 완충저류시설 용량결정시 수리·수문 분석을 통한 저류효과 검토항목을 추가적으로 제시하였다. 본 연구에서는 앞서 기술한 내용과 같이 완충저류시설 설계도서에서 도출한 항목들의 중복성을 검토하고 설계도서

작성시 활용할 수 있도록 각 부분별 위계를 고려하여 항목을 재분류하였다.

설계항목은 크게 조사, 기본설계, 실시설계로 구분하여 각각의 단계에서 어떤 항목을 설계에 포함해야 하는지 설계항목(안)을 제시하였다. 설계항목(안)을 제안하기 위해 먼저 앞서 분석된 결과를 바탕으로 완충저류시설 관련학계, 유관기관, 설계사 등 관계자 30여명의 의견청취를 실시하여 항목을 재조정하여 설계도서 구성 항목을 선정하였다. 도출된 항목은 다음 Table 4에 수록하였다.

Table 4. Design Items

Basic Plan Item	Working Plan Item
Chapter 1. Plan Ability	Chapter 1. Civil Engineering Field
1. Project Outline	1. Facility Arrangement Plan
1) Project Background and Object	1) Consideration of Facility Arrangement
2) Project Content and Range	2) Basic Concept of Facility Arrangement
3) Project History and Future Plan	3) Facility Outline
4) Project Main content	4) Structure Plan
5) Project Expected Effect	5) Structure Longitudinal Plan
2. Basic Investigation and Related Plan	6) Earthwork Plan
1) General Current State of Project Area	2. Pipe Construction Plan
2) Social Characteristics Investigation	1) Pipe Installation Plan
3) Industrial Complex State Investigation	2) Pipe Laying Plan
4) Environments Investigation	3) Floor Plan
5) Drainage Area and Existing Pipe State Investigation	4) Review of Pipe Type
6) Environmental Basic Facility State Investigation	5) Review of Excavation Method
7) Related Law and Plan Investigation	6) Review of Pipe Jacking Method
8) International and Domestic Buffering Retention Facility Case Investigation	3. Hydraulic Longitudinal Plan
3. Field Investigation	1) Basic Direction
1) Survey	2) Hydraulic Plan
2) Soil Investigation	3) Structure Longitudinal Plan
3) Discharge and Water Quality Investigation	4. Interception Facility Plan
4) GPR Exploration	1) Pumping Station Plan and Capacity Estimation
4. Location Determination	2) Plan of Motorized Valve Room
1) Basic Direction	3) Plan of Discharge Monitoring Room
2) Current State of Project Area	4) Drainage Gate
3) Review of Project Area	5) Plan of Manhole Installation
5. Review of Retention Area Setting and Retention Material	6) Etc.
1) Installation Object and Related Law	5. Pipe Foundation
2) Basic Direction	1) Consideration of Pipe Foundation Determination
3) Retention Area	2) Standard for Foundation Work
4) Determination of Retention Material	3) Review of Pipe Strength
5) Review Result	4) Estimation of Rigid Pipe Strength
6. Determination of Capacity for Buffering Retention Facility	5) Estimation of Flexible Pipe Strength
1) Related Laws and Plan	6) Review Result of Pipe Foundation
2) Review of Existing Case	6. Review of Frost Penetration Depth
3) Determination of Capacity for Buffering Retention Facility	1) Outline
4) Review of Retention Effect through Hydraulic & Hydrologic Analysis	2) Estimation of Modified Frost Penetration Depth
7. Unit Process Plan of Buffering Retention Facility	3) Estimation Method of Frost Penetration Depth
1) Intercepted Stage of Retention Material	4) Estimation Result of Frost Penetration Depth
2) Stage of Water Quality Monitoring	7. Determination of Pipe Thickness
3) Retention Stage of Retention Material	1) Standard of Determination of Pipe Thickness
4) Water Quality Test Stage of Buffering Retention Water	2) Determination of Pipe Thickness
	8. Structure Plan
	1) General Item

Table 4. Design Items (continued)

Basic Plan Item	Working Plan Item
5) Treatment Stage of Buffering Retention Water	2) Plan Standard
6) Deposit Treatment Stage of Buffering Retention Facility	3) Feasibility of Structure Plan
8. Interception Plan of Retention Material	4) Earthquake-Resistant Design
1) Stormwater Pipe State (Drainage Area State)	5) Review of Usability and Safety
2) Intercepted Pipe Plan	6) Result of Structure Analysis
9. Water Quality Monitoring for Inflow	9. Review of Structure Foundation Safety
1) Review of Monitoring Device for General Item	1) Outline
2) Review of Monitoring Device for Hazardous Material	2) Determination of Foundation Type
3) Determination of Monitoring Facility	3) Standard of Foundation Safety
10. Retention Plan for Retention Material	4) Soil Constant
1) Basic Direction	5) Review of Foundation Safety
2) Retention Plan during Clean Day	6) Result of Safety Analysis
3) Retention Plan during Rainy Day	7) Quality Management Plan
4) Retention Plan for Accident Spill	10. Review of Excavation Method
11. Water Quality Test for Buffering Retention Water	1) Comparison and Review of Excavation Method
1) Location and Period of Sample Collection for Water Quality Analysis	2) Comparison and Review of Support Method
2) Item of Water Quality Test	11. Review of Slope Stability
3) Executing Organization of Water Quality Test	1) Outline
12. Treatment Plan for Buffering Retention Water	2) Method of Soil Slope Analysis
1) Treatment Concept of Accident Spill	3) Applied Groundwater Level
2) Review of Treatment Method of Accident Spill	4) Review of Safety Ratio of Slope
3) Management Plan of Buffering Retention Facility	5) Result of Slope Stability Analysis
4) Connecting Process Plan for Waste Water Treatment Facility	12. Temporary Facility Plan
5) Transfer and Discharge Plan of Buffering Retention Water	1) Safety Consideration and Standard for Each Facility
6) Review of Contaminant Removal Device	2) Load Condition for Each Facility
7) Review of Washing Equipment	3) Temporary Facility Plan for Each Facility
Chapter 2. Construction Ability	13. Structure Waterproof Type Plan
1. Construction Plan	1) Problem and Countermeasure for Existing Waterproof Type
1) Preliminary Review Item	2) Classification of Waterproof Type for Each Structure
2) Establishment of Construction Management Plan	3) Determination of Waterproof Type for Each Structure
3) Traffic Management Plan	14. Stormwater Drainage Plan
4) Rock Management Plan	2) Basin and Drainage Area Setup
2. Process Management Plan	2) Rainfall Analysis
1) Process Plan	3) Runoff Estimation
2) Detailed Process Plan	4) Stormwater Drainage Plan
3) Management and Countermeasure for Process Impediment	Chapter 2. Architecture Field
3. Quality Management Plan	1. Architecture Plan
1) General Plan for Construction Quality Management	1) Outline
2) Test Standards for Quality Management per Processes	2) Exterior Material Detail
Chapter 3. Maintenance Management	3) Floor Plan, Section Plan, Elevation Plan
1. Facility Operation and Maintenance Management	2. Structure Plan
1) Organization Composition for Maintenance Management	1) Material and Standard Strength
3) Operation Management and Education	2) Analysis and Application of Various Load Condition
3) Current State Investigation and Improved Action	3) Structure Analysis
2. Management Standard	3. Machine Equipment Plan
1) Water Quality Monitoring	1) Review of Related Law
2) Accident Spill and Initial Stormwater Retention	2) Air-Conditioning Equipment Plan
3) Water Quality Test for Retention Water	3) Ventilation Plan
4) Treatment of Retention Water	4) Firefighting Equipment Plan
5) Deposit Treatment	5) Machine Equipment Installation Plan
3. Safety Management Plan	Chapter 3. Mechanical Field
1) Safety Management Plan based on Disaster Types	1. Basic Direction
	1) Outline

Table 4. Design Items (continued)

Basic Plan Item	Working Plan Item
2) Protection Plan for Buffering Retention Facility	2) Consideration of Mechanical Equipment
3) Cooperation of Related Agency and Emergency Restoration System	3) Arrangement Plan
4) Safety Securement Plan for System and Equipment	4) Durability Securement and Proper Material Application
4. Project Management Plan	2. Plan Condition
1) Feasibility of Project Management Organization	1) Capacity of Buffering Retention Facility
Chapter 4. Economic Feasibility	2) Inflow of Buffering Retention Facility
1. Feasibility of Economic Analysis	3) Inflow of Pumping Station
1) Determination of Plan and Economic Analysis	3. Comparison of Process Plan and Main Machine for Each Equipment
2. Feasibility of Management Cost	1) Valve Room and Pumping Station Equipment
3. Economic Securement Plan for Each Process	2) Inflow Pipe Equipment
Chapter 5. Environmental Review	3) Screen Equipment
1. Reduction Plan of Environmental Pollution during Construction	4) Retention Tank Equipment
1) Environment Management Plan	5) Cleaning Equipment
2) Draw and Reduction Plan of Environmental Damage Factor during Construction	4. Machine List
3) Protection Plan for Animals, Plants, and Cultural Assets in the case of necessity	1) Outlet Pumping Station Equipment
4) Management Plan of Soil Pollution in the case of necessity	2) Buffering Retention Facility Equipment
2. Waste Management Plan	Chapter 4. Electricity & Instrument and Control Field
1) Waste Occurrence Factor and Management Plan	1. Electricity Plan
2) Waste Reduction Plan and Recycle Plan	1) Project Outline
3) Waste Emission Management Plan	2) Project Range
3. Environment-Friendly Plan	3) Related Law and Standard
1) Determination of Eco-Friendly Equipment for Each Field	4) Electric Power Equipment
Chapter 6. Etc.	5) Architecture Electric Equipment
1. Advanced Prevention and Preparation Plan for Expected Civil Complaint	6) Disaster Prevention Equipment
1) Management Plan for Civil Complaint	7) Energy Saving Plan
2) Preparation Plan for Expected Civil Complaint	2. Instrument and Control Equipment
2. Education Plan for Resident	1) Outline
3. Reduction Plan for Civil Complaint	2) Basic Direction
1) Reduction Plan of Expected Civil Complaint for Each Process	3) Project Range
2) Reduction Plan of Expected Civil Complaint for Each Location	4) Related Law
4. Handling Plan for Civil Complaint	5) Monitoring Control Equipment
	6) Remote Monitoring Control Equipment
	7) Instrument Equipment
	8) Uninterrupted Power Supply Equipment
	9) CCTV Equipment
	Chapter 5. Landscaping Field
	1. Basic Direction
	2. Concept of Main Planting
	3. Determination of Applied Species of Trees
	4. Planting Plan
	5. Planting Planning Map

3. 결론

본 연구에서는 2014년부터 2020년까지 주요 완충저류시설 설계 도서를 수집·분석하여 완충저류시설 설계시 활용된 항목을 도출하고 검토하였다. 분석결과 각각의 설계도서에서 설계에 반영된 항목이 상이한 경우를 확인할 수 있었다. 완충저류시설 설계를 위한 명확한 가이드라인 및 관련 연구가 부족한 실정으로 본 연구에서 제안한 항목을 설계에 반영한다면 좀 더 내실 있는 완충저류시설의 설계를 위한 기반조성이 가능할 것이다. 또한, 완충저류시설과 관련된 연구가 지속적으로 필요한 것을 확인할 수 있었다.

Acknowledgment

This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government (MSIT) (No. 2022R1A2C200403411).

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