### Use of Recycled Water Coming from De La Salle University - Dasmariñas Sewage Treatment Plant for Bathroom Fixtures and Irrigation of DLSU-D High School Building

Thesis Presented to the Faculty of Environmental and Sanitary Engineering College of Engineering, Architecture, and Technology De La Salle University- Dasmariñas Dasmariñas City, Cavite

In Partial Fulfillment of the Requirements for the Degree Bachelor of Science in Environmental and Sanitary Engineering

> Archie R. Feranil Rey An Francis S. Geromo Justin D. Gonzalez

> > March 2015

### ABSTRACT

### Use of Recycled Water Coming from De La Salle University - Dasmariñas Sewage Treatment Plant for Bathroom Fixtures and Irrigation of DLSU-D High School Building

By

#### Archie Feranil, Rey An Francis Geromo, and Justin Gonzalez

The purpose of this research is to conserve the water through recycling of the effluent water of the DLSUD Sewage Treatment Plant. The effluent water comes from Rapid Sand filter will be used in lavatory, urinal, and irrigation of the new High School Building.

Specifically, this study tried to (1) determine the classification of the effluent of the De La Salle University- Dasmariñas Sewage Treatment Plant in terms of BOD, COD, TDS, and pH, (2) determine the design of the water piping system and storage from the effluent of the Sewage Treatment Plant to the High School Building and, (3) to design an integrated process to use the Sewage Treatment Plant effluent water in irrigation and bathroom fixtures in the High School Building

The research is structured in five main chapters: (1) Introduction, discussing the statement of the problem, objectives of the study, scope and limitation and conceptual framework; (2) Review of the Related Literature, addressing the related topic in this research conducted to different literature and studies both local and foreign country; (3) Methodology, deliberating the methodological framework and the methods used in the research; (4) Data and Results, specify the result of the water testing and design aspect; and (5) Summary of Findings, Conclusion, and Recommendation, discussing the output of the study.

After analyzing the data and result, the treated water from the Rapid Sand Filter is safe for flushing water for toilet, urinals, and irrigation. The quantity of the effluent water from the STP is more than the water needed in the High School Building. The researchers recommend to use the excess water in the other buildings of DLSUD.

## **TABLE OF CONTENTS**

PRELIMINARIES	Page No.
Title Page	i
Certification and Approval Sheet	ii
Acknowledgement	iii
Abstract	iv
Table of Contents	v
List of Figures	vii
Chapter 1: The Problem and its Background	
1.1 Introduction	1
1.2 Statement of the Problem	4
1.3 Statement of the Objectives	5
1.4 Significance of the Study	5
1.5 Scope and Limitations of the Study	7
1.6 Conceptual Framework	8
1.7 Definition of Terms	10
Chapter 2: Review of Related Literature and Studies	
2.1 Foreign Literature	12
2.2 Local Literature	16
2.3 Reclaimed Water Storage	17
2.4 Water Treatment	18
2.5 Treatment Method	20
2.6 Water Quality Standards	22
2.7 Precautionary Measures	24
2.8 Pumping System	26
2.9 Pipeline Design	28
2.10 Equation	29
2.11 Relevance of the Study	33

## Chapter 3: Research and Methodology

3.1 Flow Chart Diagram	34	
3.2 Research Design	36	
3.3 Direct-Data Survey (Interview)	37	
3.4 Case-Study Method	37	
3.5 Data Processing and Analysis	39	

## Chapter 4: Data and Results

4.1 Water Quality	40
4.2 Land Survey	42
4.3 Determination of Sizes of Pipes	43
4.4 Water Demand	44
4.5 Rapid Sand Filter Design	46
4.6 Pipe Layout and Water Distribution	51
4.6.1 Blue Dye	53
4.6.2 Precautionary Measures	53
4.7 Specification of Pump	56
4.8 Cost and Estimate of the Project	56
Chapter 5: Recommendation and Conclusion	
5.1 Summary of Findings	60
5.2 Conclusion	61
5.3 Recommendation	63

### BIBLIOGRAPHY

65

## APPENDICES

Appendix A: Design of Reservoir, Pipe, and Rapid Sand Filter	67
Appendix B: Water Test Result	75
Appendix C: Rapid Sand Filter Design (Small Scale)	78
Appendix D: Isometric View of Pipe	80
Appendix E: Existing Pipe Layout per Floor	84
Appendix F: Proposed Pipe Layout per Floor	86
Appendix G: Water Supply Fixture	88
Appendix H: List of Pictures	89



## List of Tables

Table 2.1: Advantages and Disadvantages of Other Treatment Method	20
Table 2.2: Water Quality Criteria for Conventional and Other Pollutants	22
Table 4.1: Water Quality Result	40
Table 4.2: Distances and Elevation	42
Table 4.3: Size of Pipe in HS Building	43
Table 4.4: Water Demand Table of the High School Building	44
Table 4.5: Water Demand by Plumbing Fixture	45
Table 4.6: Cost and Estimate	56
Table 4.7: Electric Consumption	58

# List of Figure

Figure 1.1 Research Paradigm	9
Figure 3.1 Research Plan	34
Figure 3.2 Schematic Diagram	35
Figure 4.1 Rapid Sand Filter (Actual Design)	46
Figure 4.2 Operation during Filtration	48
Figure 4.3 Operation during Backwashing	50
Figure 4.4 Pipe Layout from STP to High School Building	51
Figure 4.5 Rapid sand to OHT water distribution	52
Figure 4.6 Irrigation Design	54
Figure 4.7 Cistern tank to tank for irrigation	55