

---

# ***INCREASING SUSTAINABILITY IN CEBU***

*CREATING A SAFER AND HEALTHIER ENVIRONMENT AROUND THE TANGON RIVER*

---

*DECEMBER 5<sup>TH</sup>, 2016 - CEBU CITY, PHILIPPINES*



IDE BENJAMIN MARIA OPDAM  
PRESIDENTIAL COMMISSION FOR THE URBAN POOR  
ROTTERDAM UNIVERSITY OF APPLIED SCIENCES  
WATER MANAGEMENT  
SUPERVISORS: MR. T.H. HEIKOOP, MRS. C.T. MANLOSA - OSANO



## Preface

This article is the final product of the internship which is part of the third year of the study Water Management of the Rotterdam University for Applied Sciences. During this internship, a research is executed regarding the water quality in a river in the Philippine province Cebu. There has been focused on an integral solution for the pollution problems in the secluded river branches of the Tangon River. Therefore, a solution is designed that tackles both problems of water quality and water safety.

This research is a contribution to all people who will be involved with water quality and water safety problems in the future within the Philippines. In special this research should help the Philippine government creating appropriate solutions.

Furthermore, this article is established in collaboration with Presidential Commission for the Urban Poor and the Rotterdam University of Applied Sciences. Special thanks to Regional Director of the Presidential Commission for the Urban Poor, Chloe T. Manlosa-Osano and Attorney Edmund Lao of the Danao City council.

## Summary

During the research of the Tangon River, the spatial problems have been extensively examined. After several field studies and a literature study, the analyses indicate several important issues. In particular, the water quality due to the serious pollution. Additionally, there is a high flood hazard in the area, caused by intense rainfall and high tide of the sea. This increases the danger of floods within the river banks for the residents.

The highest risks occur in the secluded river branches in the barangays Tay-tay and Lo-oc. The high gradient is used through clever use of heights to create a natural system that will decrease pollution and store water.

To ensure the quality and validity of the research the interests of the stakeholders are included. The project has been extensively discussed with these various stakeholders. This is to ensure that the future solution/procedure is as close as possible to the desires and requirements of the stakeholders.

## Introduction

Cebu is the second largest Metropole of the Philippines with around 3 million residents. The province Cebu is located within the islands of the Visayas in the Philippines. The capital of Province Cebu is Cebu City and is located in the central eastern part of the province.

In the last decade Cebu developed its businesses and industry enormously. Furthermore, the population in Cebu is still increasing. These increments are taking its toll on the environment in Cebu. Infrastructure, electricity and water supply facilities keeps up, but the waste water treatment lags behind. Some waste water is treated in septic tanks, but most of it is discharged directly into the waterways.

The climate of the Cebu Region is dominated by a wet- and a dry season. In the wet season, discharge of waste water with pollutants, causes enormous pollution in the rivers of Cebu. In the dry season, however, there is almost no rain, the rivers contain decomposed sewage, and the stench is terrible (Kitakyushu Initiative Network Cities).

## Problem

The enormous pollution because of the lag of the waste water treatment in Cebu caused the interest in the waterways of Cebu. The first few weeks of field research have shown highly contaminated water bodies in Cebu, depriving the residents from their quality of life significantly. News bureau Sunstar and an interview with City Counsellor Edmund Lao confirm these as major issues (Sunstar, 2015) (Lao, 2016). Furthermore, flood hazard maps have shown that the waterways in Cebu are under threat of floods because of storm water runoff (Nationwide Operational Assessment of Hazards, 2016). Multiple news articles from Cebu Daily News show the major impact these floods have on its surroundings, because of a shortage in water storage (Cebu Daily News, 2013).

## Objective

The goal of this research is to increase the water storage and to find a solution for the water quality problems in the Tangon River in Cebu. This is done with a design that can store water and influence the water flow. By increasing the water storage the impact of heavy rainfall will be reduced and the discharge of waste will be constant. It is the intension that the stakeholders create awareness of this life improving opportunity.

## Research questions

In order to find out how the design can contribute to solving these problems the following research questions are created. The main research question is: "Which recommendations can be given to increase the water storage and to improve the river's water quality of a river in Cebu?". This research question can be divided into multiple sub questions.

- I. What are the (spatial) characteristics of the Tangon River's catchment area that enhance the risks for floods and pollution?
- II. Which stakeholders to take into account looking for possible measures?
- III. What design contributes to increasing water storage and improving of the river's water quality?

## Research method

### 1. Sub question: Characteristics

The first sub question is: "What are the (spatial) characteristics of the Tangon River's catchment area that enhance the risks for floods and pollution?". The answer to this question will show the specific critical problems and opportunities within its region (the best location(s) to implement a design). These problems and opportunities are shown in a map.

### *Literature study*

To show the specific critical problems and opportunities of the Tangon River the water system and spatial area will be further analysed.

### *Field study*

To expand the information sources the field study confirm or invalidate the critical problems and opportunities shown in the created maps based upon the literature study. During the trip along the Tangon River pictures are made to explain why an area is confirmed or invalidated. Next to the pictures of the landscape of the areas, examinations are done when an area

is confirmed. This examination consists out of checking if the area is mapped the same as found in the literature. Crucial to the design is that the area is mapped correctly.

## 2. Sub question: Stakeholder analysis

The second sub question is: "Which stakeholders to take into account looking for possible measures?". It is important to know which stakeholders are involved when working towards a design. In this sub question stakeholders are interviewed and asked if they have any advice for the development of the design.

### *Influence vs interest*

A list of stakeholders will be composed to give an overview of the key stakeholders in the area around the Tangon River. The stakeholders that are contacted are listed below. Stakeholders which are identified during the research are added to the list if it has value to the research.

- *Presidential Commission for the Urban Poor, Mrs Chloe T. Manlosa-Osano*
- *City Engineering and Public Works, Engr. Rosette Villaflor*
- *Municipality of Danao, City counsellor Mr Edmund Lao*
- *General Services Office, Engr. Virolo Armenteros*
- *Danao Waterworks, Engr. Morales*
- *Disaster and Risk Management, Hon. Roland Reyes*
- *Residents river bank, Mr Alanio Manulat*

Also the influences are measured with the interests to get acknowledged with these proportions.

### *Interview*

The interview confirmed or invalidate the data that is put into the maps and tell if adjustments are needed. Furthermore, sketches of possible solutions are shown to the stakeholders. The thoughts and possible advice the stakeholders have are noted.

The local residents and government officials are interviewed. Every stakeholder got a set of individual questions.

## 3. Sub question: Design

The third sub question is: "What design is possible on which location(s)?" . The answer to this question resulted into a design that shows the opportunities for the Tangon River to reduce the storm water runoff, increase the water storage and to improve the river quality.

### *Program of requirements*

To ensure the quality of the design a program of requirement has been setup. The design needs to meet these requirement to be successful. The design functions are divided into soft and hard design functions. Hard design functions are required for the design and soft design functions are optional. Furthermore, the boundary conditions are set to ensure the mind map has enough focus to the main goal.

### *Mind Map*

To organise all the possible ideas during the brainstorms the Mind Map is used. The Mind Map helps to find as many ideas as possible and organize them. It is important to set the main goal and to divide the main points from the sub points. This created the overview of all the ideas and gives the chance to discuss them.

## SWOT

The SWOT analysis is used to show the differences between the designs. Mind tools says: “A SWOT Analysis is an useful technique for understanding your Strengths and Weaknesses, and for identifying both the Opportunities open to you and the Threats you face.” (MindTools, 2015) So this technique is useful to help understanding the strengths, weaknesses, opportunities and threats of each design. In Figure 1 and Figure 2 the template of a SWOT analysis is filled in with two different designs.

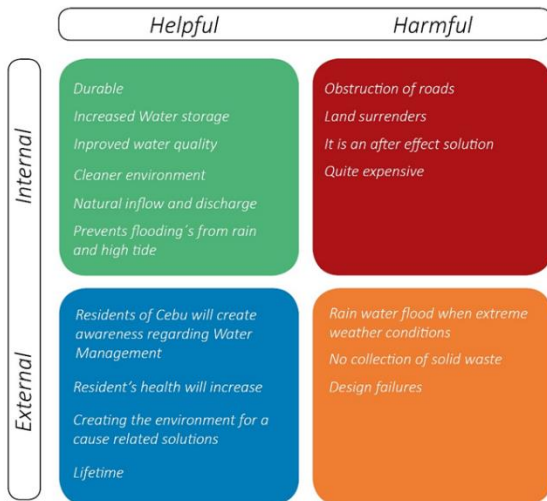


Figure 1 Concrete design - Strengths, Weaknesses, Opportunities, Threats (MindTools, 2015) (N. Boer & I.B.M. Opdam, Adobe Acrobat )

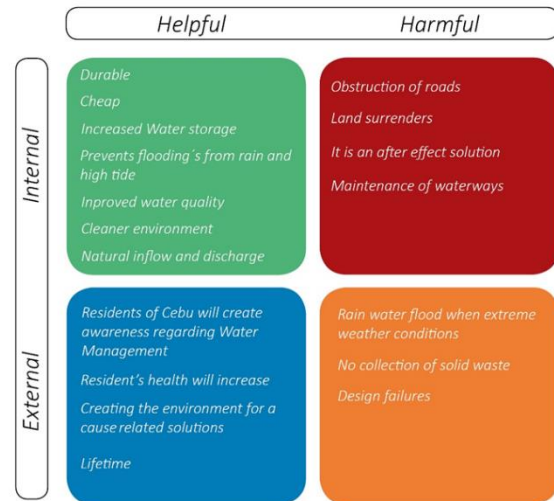


Figure 2 Vegetation design - Strengths, Weaknesses, Opportunities, Threats (MindTools, 2015) (N. Boer & I.B.M. Opdam, Adobe Acrobat )

Furthermore, the data of a SWOT analysis can be analysed with the use of a Confrontation Matrix. According to Expert Program Management the Confrontation Matrix allows you to analyse each different combination of strengths, weaknesses, opportunities, and threats (Expert Program Management, 2014). When completed, the Confrontation Matrix will identify the most important strategic issues the design is facing, as shown in Figure 5 and 6.

## Results and conclusions

When all findings from the different analyses, water system analysis, spatial analysis and the stakeholder analysis are combined a clear picture of the problems and desiderates appears, as shown in Figure . An increase in water storage and an improvement of the water quality of the secluded river branches is needed to improve the health environment and to prevent floods originating from rain shower and high tide. According to these desiderates a program of requirements is created. For the implementation of a design for these desiderates, multiple stakeholders play a part for a success. The Danao City Counsel and its residents play the biggest part and are included in the research.

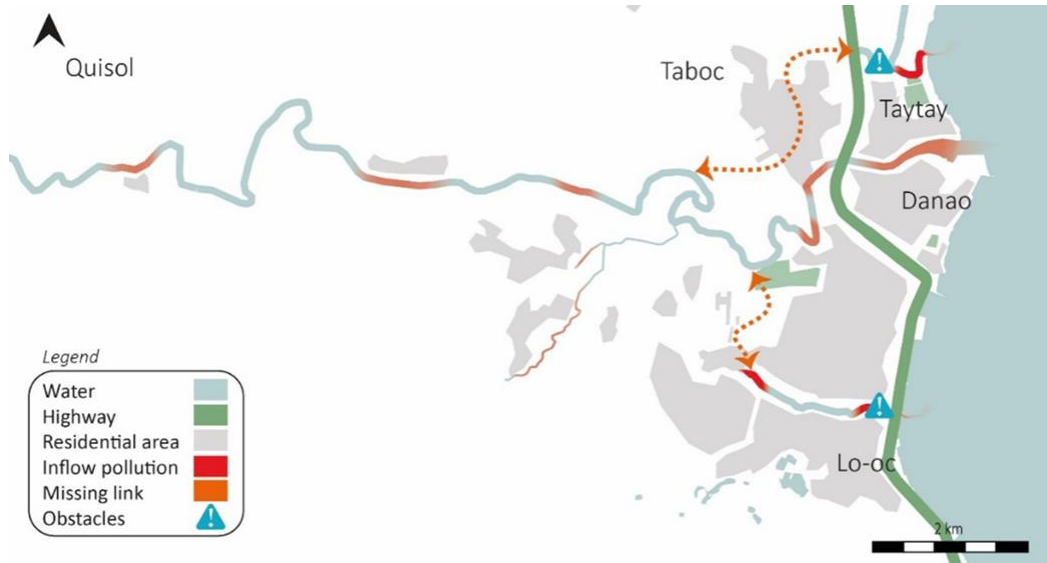
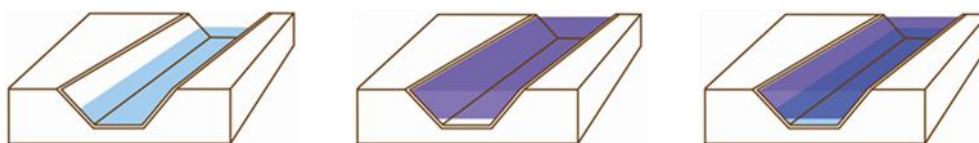


Figure 3 Three critical problems regarding the water quality (OpenStreetMap, 2016) (N. Boer & I.B.M. Opdam, Field research, 2016) (N. Boer & I.B.M. Opdam, Adobe Acrobat )

By connecting the Tangon River to the secluded river branches, North and South of Danao City a water flow appears that will flush out the pollution in the new connected river branches. This water flow will flush the pollution to the debouchments in the east. This will ensure the disappearance of bad smell and bacteria that could have caused diseases.

In combination with the added water flow the solid waste will be collected using a triangle raster in the debouchments to prevent loss of marine life near the coast. To prevent the high tide from entering the new water system valves are installed to keep the water outside.

Next to these improvements the design is also dimensioned to withstand extreme weather showers that occur once in four years, this creates a reduce in flood hazards. And creates a total water storage of 11.439,3 m<sup>3</sup>, as shown in Figure 4. The combination of these solutions will create an environment for a healthy and sustainable water system in Danao City.



Flush water	+	Rain water	=	Total storage
1.143,93m <sup>3</sup>	+	10.295,37m <sup>3</sup>	=	11.439,3 m <sup>3</sup>

Figure 4 Diversion of water storage (N. Boer & I.B.M. Opdam, Adobe Acrobat )

## Recommendations

There are two designs that can be implemented, a concrete design and a vegetation design. After comparing the strengths, opportunities, weaknesses and threats in a Confrontation Matrix there is chosen for the concrete design since this design has a higher score, as shown in Figure 5 and 6. In the remaining texts the recommended points of interest are described.

When implementing this design the water storage will increase, this causes the reduce of the consequences of heavy rainfall.

When people see the design, residents will create more awareness regarding water quality and preventing floods, alluring them to create a mind-set for a cleaner environment.

The people do not have to regulate the water flow since the dam will create the right amount of flow. The only maintenance that is needed is the collection of solid waste and maintaining the waterway.

The biggest opportunity is the creation of a much healthier environment. Diseases will be less likely to occur since the water quality is majorly improved.

The biggest weakness is the obstruction of roads. There are a few intersections in the design between rivers and roads that need construction for the waterways to be connected that the residents will experience as annoying.

Another weakness is that the design is an aftereffect solution, this means that the solution solves the symptoms of the problem. This design cannot serve as a solution for the behaviour towards the waste management of the residents in the riverbanks. A social research is needed to create a better waste management in the riverbanks between the government and residents.

One of the best strengths on the other hand is that the concrete design will create an environment for a cause related solution. A cause related solution would be a place where waste no longer ends up in the waterways. This is the social aspect of the problem. This design gives Danao City a solution for its waste problems and a platform to improve the water quality even further. Recommended is a follow-up social study to research a way where waste is rightly disposed of.

		Opportunities			Threats			
		Residents of Cebu will create awareness regarding de challenges of Water Management	Lifetime	Residents health will increase	Creating the environment for a cause related solution	Rain water flood when extreme weather conditions	No collection of solid waste	Design failures
Strengths	Durable	+	++	0	+	-	-	-1
	Increase water storage	++	0	0	0	-	0	0
	Improved water quality	++	0	++	+	0	--	2
	Cleaner environment	++	0	+	+	-	--	0
	Natural inflow and discharge	0	0	0	++	-	0	+
	Prevents flooding's originating from rain and high tide	++	0	0	+	-	0	--
Weaknesses	Quite expensive	-	0	0	+	0	0	++
	Obstruction of roads	-	0	0	0	0	0	-1
	Maintenance	++	0	0	0	0	-	0
	Land surrenders	-	0	0	+	0	0	0
It is an aftereffect solution		+	0	0	+	-	-	-1
		7	2	3	6	-6	-7	-4

Figure 5 Confrontation Matrix - Concrete design

		Opportunities			Threats			
		Residents of Cebu will create awareness regarding de challenges of Water Management	Lifetime	Residents health will increase	Creating the environment for a cause related solution	Rain water flood when extreme weather conditions	No collection of solid waste	Design failures
Strengths	Durable	+	+	0	+	0	-	-1
	Cheap	+	0	0	0	0	0	0
	Increase water storage	++	0	0	0	+	0	-
	Improved water quality	++	0	++	+	0	--	2
	Cleaner environment	++	0	+	+	-	--	0
	Natural inflow and discharge	0	0	0	++	-	0	+
Weaknesses	Prevents flooding's originating from rain and high tide	++	0	0	+	-	0	--
	Obstruction of roads	-	0	0	0	0	0	-1
	Maintenance	++	0	0	0	0	-	-1
	Land surrenders	-	0	0	+	0	0	0
It is an aftereffect solution		+	0	0	+	-	-	-1
		10	1	3	7	-6	-5	-5

Figure 6 Confrontation Matrix - Vegetation design

## Bibliography

- Cebu Daily News. (2013, July 17). Flood sweep Danao City Brgys, displace 30 families. *Cebu Daily News*. Retrieved from [newsinfo.inquire.net/446629/floods-danao-brgys-displace-30-families](http://newsinfo.inquire.net/446629/floods-danao-brgys-displace-30-families)
- Expert Program Management. (2014, December 4). *The Confrontation Matrix*. Retrieved from Expert Program Management: <http://www.expertprogrammanagement.com/2011/08/the-confrontation-matrix/>
- Kitakyushu Initiative Network Cities. (n.d.). *River Improvement Project in Cebu City*. Retrieved from [http://kitakyushu.iges.or.jp/docs/demo/cebu\\_philippines/report.pdf](http://kitakyushu.iges.or.jp/docs/demo/cebu_philippines/report.pdf)
- Lao, E. (2016, September 6). City Counselor of Danao. (I. I. Opdam, & N. N. Boer, Interviewers)
- MindTools. (2015, December 31). *SWOT analysis*. Retrieved from MindTools: [https://www.mindtools.com/pages/article/newTMC\\_05.htm](https://www.mindtools.com/pages/article/newTMC_05.htm)
- N. Boer, N., & I.B.M. Opdam, I. (2016). Photography. *Photographs*. Presidential Commission for the Urban Poor, Cebu.
- N. Boer, N., & I.B.M. Opdam, I. (n.d.). Adobe Acrobat. *Adobe InDesign & Illustrator*. Presidential Commission for the Urban Poor, Cebu City.
- Nationwide Operational Assessment of Hazards. (2016). Flood Hazard Danao. Danao, Cebu, Philippines. Retrieved from <http://noah.dost.gov.ph/#/section/geoserver/flood100>
- Sunstar. (2015, June 04). Butuanon 'worst river in the Philippines'. *Sunstar*, p. 1. Retrieved from <http://www.sunstar.com.ph/cebu/local-news/2015/06/04/butuanon-worst-river-phils-411231>



# Appendix 1, Design

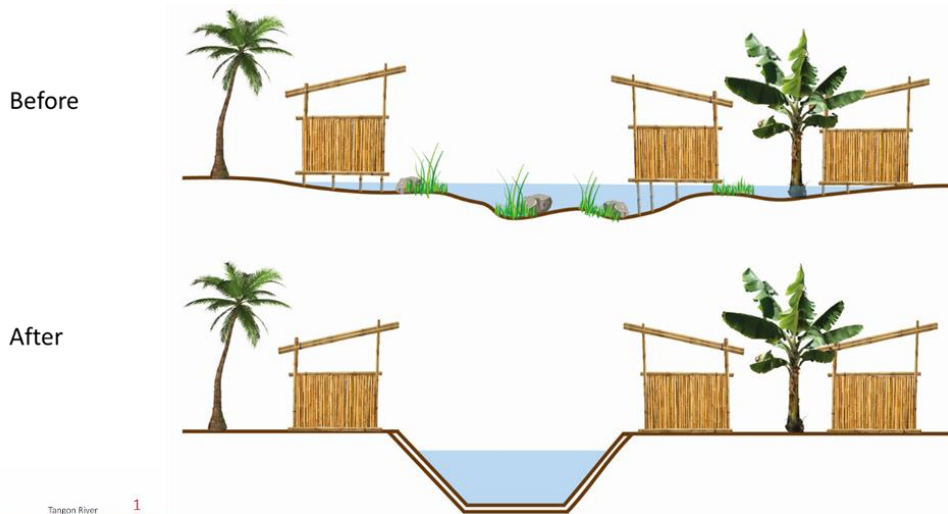


Figure 7 Situations of the waterway in the river branches (N. Boer & I.B.M. Opdam, Adobe Acrobat )

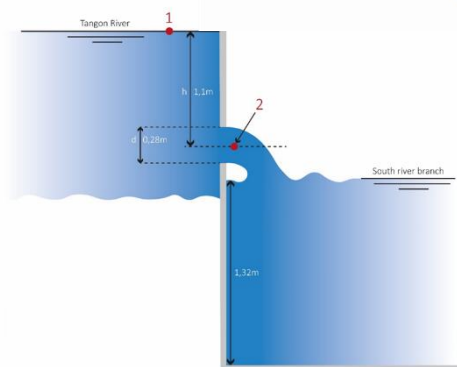


Figure 8 Cross section dimensions Inflow (N. Boer & I.B.M. Opdam, Adobe Acrobat )

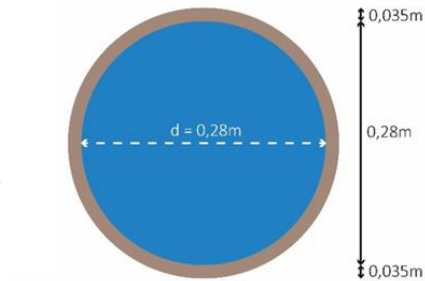


Figure 9 Cross section dimensions Inflow release gab (N. Boer & I.B.M. Opdam, Adobe Acrobat )

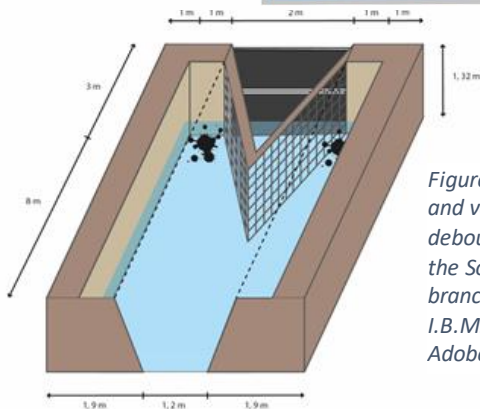


Figure 10 Raster and valves in the debouchment of the South river branch (N. Boer & I.B.M. Opdam, Adobe Acrobat )

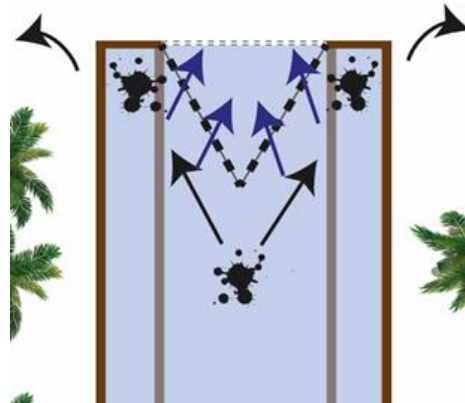


Figure 11 Operating of catching solid waste (N. Boer & I.B.M. Opdam, Adobe Acrobat )

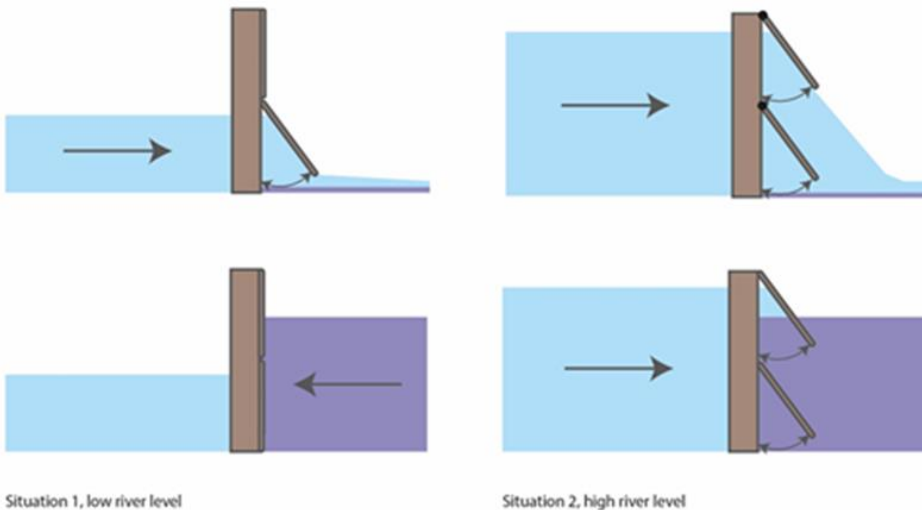


Figure 12 Different situation between the river- and sea level (N. Boer & I.B.M. Opdam, Adobe Acrobat )

## Appendix 2 News article, Danao to flush out water from 2 barangays



Flushing out. Students suggest that the water in Tangon River in Danao City be diverted to the catchments in other areas to flush out water there. (Sun.Star Foto/Allan Cuizon)

THE Danao City Council will deliberate this week on how much it will cost to flush out stagnant water in two barangays to eliminate diseases and prevent floods.

City Councilor Edmund Lao said the stagnant water is in catchment areas situated in Barangays Looc and Taytay.

The recommendation to remove the stagnant water came from two foreign students who conducted a study in compliance with their academic requirements abroad.

The students, Ide Opdam and Niels Boers, of the University in Rotterdam School of Applied Sciences in The Netherlands, recommended that water from Tangon River be used to clean up catchments in Looc and Taytay.

The water from Tangon River is flowing directly to the sea while the water in Looc and Taytay remains stagnant and can no longer flow to the sea because of garbage thrown by informal settlers in the two barangays, and the growing nipa plants.

The foreign students recommended that the water from Tangon River, which is located in the upper portion of Danao City, be diverted to Looc and Taytay to flush out the stagnant water.

However, Opdam and Boers also recommended to the City Council that the stagnant water shall be treated first to prevent pollution in the sea.

The students presented the results of their study during the City Council session last week, presided over by Vice Mayor Thomas Mark Durano and attended by 10 city councilors.

### **Attendance**

Also in attendance were general services head Verulo Armenteros, City Engineering Office head Rosette Villaflor and Fe Morales of the City Waterworks Office.

“They insisted that the project, if implemented, will ensure continuous flow of water to the branches of the river until it reaches the sea. With this, it would eliminate stagnant water thereat, flush out wastes, hence, prevent diseases and flood,” Lao said.

Durano assured the students that the City Government will consider their study for implementation.

Meanwhile, Reyes said that City Mayor Ramon “Nito” Durano III has created the River Management Board now headed by City Administrator Oscar Rodriguez Jr.

Reyes said the creation of the board is also in relation to the bulk water supply deal that the City Government has entered into with Metropolitan Cebu Water District.

**Published in the Sun.Star Cebu newspaper on November 29, 2016. By ELIAS O. BAQUERO**

## Appendix 2 Resolution letter



Republika ng Pilipinas  
Lungsod Ng Danao  
SANGGUNIANG PANLUNGSOD

Office of the Secretary to the Sanggunian

---

15<sup>th</sup> SANGGUNIANG PANLUNGSOD

18<sup>th</sup> REGULAR SESSION

EXCERPT FROM THE MINUTES OF THE REGULAR SESSION OF THE 15<sup>TH</sup>  
SANGGUNIANG PANLUNGSOD OF THE CITY OF DANA O, PROVINCE  
OF CEBU, HELD ON TUESDAY, NOVEMBER 22, 2016 AT  
THE CITY SESSION HALL

PRESENT:

Hon. Thomas Mark H. Durano	- Vice-Mayor / Presiding Officer
Hon. Jerard G. Almendras	- Presiding Officer Pro Tempore
Hon. Jose Thaddeus B. Roble Jr.	- Floor Leader
Hon. Rodrigo G. Giango	- Member
Hon. Jovelina M. Enriquez	- Member
Hon. Celso C. Meca	- Member
Hon. Leonilo C. Canson	- Member
Hon. Edmund T. Lao	- Member
Hon. Lovell G. Mahinay	- Member (Rep. LB)

ON OFFICIAL BUSINESS:

Hon. Kristine C. Gorre	- Member
Hon. Roland P. Reyes	- Assistant Floor Leader

ABSENT:

Hon. Jaime A. Duterte Jr.	- Asst. Pres. Officer Pro Tempore
---------------------------	-----------------------------------

RESOLUTION NO. 278

Series of 2016

(Author: Hon. Edmund T. Lao)

RESOLUTION EXPRESSING GRATITUDE TO MR. IDE OPDAM AND MR. NIELS  
BOER OF THE ROTTERDAM UNIVERSITY OF APPLIED SCIENCES,  
NETHERLANDS, FOR THE STUDY CONDUCTED FOR THE CREATION  
OF SAFER AND HEALTHIER CATCHMENT AREAS  
OF TANGON RIVER

WHEREAS, Mssrs. Ide Opdam and Niels Boer, students of the Rotterdam University of Applied Sciences, Netherlands, conducted a study for the rehabilitation of the river branches of the Tangon River;

WHEREAS, said students presented the results of their initial study before the Sangguniang Panlungsod of the City of Danao; they proposed to create safer and healthier catchment areas of Tangon River;

WHEREAS, based on the results of their study, their proposals will be beneficial to the people of the City of Danao; it would help clean the areas; eliminate disease and avoid flooding, among others;

WHEREAS, it is proper and fitting to express gratitude to Mssrs. Opdam ad Boer for their efforts and their help to the people and the City of Danao.

NOW, THEREFORE:

Be it resolved by the 15<sup>th</sup> Sangguniang Panlungsod of the City of Danao, Province of Cebu to express as it hereby expresses gratitude to Mssrs. Ide Opdam and Niels Boer of the country of Netherlands for their dedication and service to the people and the City of Danao, Cebu;

Resolved, further to furnish copies of this resolution to Mr. Ide Opdam and Mr. Niels Boer for their information and safekeeping;

Resolved, finally to furnish copies of this resolution to the Honorable City Mayor, to the City Administrator's Office, to the City Planning and Development Office, to the City Environment and Natural Resources Office, to the General Services Office, to the City Engineering Office and to others concerned for information and guidance.

Adopted Unanimously, this 22<sup>nd</sup> day of November, 2016 on motion of Hon. Edmund T. Lao, duly seconded by Hons. Jovelina M. Enriquez & Celso C. Meca.

===

CERTIFIED CORRECT:

  
**CHERYL B. JUANICO**  
Secretary to the Sangguniang Panlungsod

APPROVED:

  
**THOMAS MARK H. DURANO**  
Presiding Officer