Appendices

CT 4061-09 Multidisciplinary project

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Summary

Appendix A: Problem Definition

Appendix A: Problem definition first gives a brief description of the problems encountered in this report regarding Manado City.Two of the challenges of Manado will be investigated. In the year of 2003 a major flood occurred in the city, causing a great damage to the city with many casualties. Risk of flooding is still present today. Secondly a challenge at the border of the city is chosen. The coastline of Manado suffers at specific locations from erosion, possibly caused by early development of newly reclaimed land. Besides these technical aspects also the management, law and governance, and financial aspects will be encountered in this report to give an impression of the pros and cons of the Indonesian way to handle things.

Appendix B: Field trip Manado

To get a good idea of the current situation alongside the Manado shoreline, a field trip took place at the 24th of august. During this trip several places along the coast were reviewed about their present state, the way of execution during construction and the possible improvements. The main focus was on the coastal protection, although also some places near the small rivers were visited. Appendix B: Field trip Manado gives a short impression of the reviewed places.

Appendix C: Coastal Analysis

This appendix contains the analysis of the shoreline of Manado City, regarding erosion problems. In this analysis, the shoreline is divided in three different parts. The southern part of the shoreline suffers from erosion due to heavy wave attack. Local community already designed a coastal protection, which is a good and durable design, to stop the erosion. The central part of the shoreline contains a lot of reclaimed areas with over dimensioned protections. Reclaimed areas do not suffer from erosion, but construction of it led to a change in current pattern along the coast. The northern part of the shoreline has partly eroded because of the change in current pattern. A large area has disappeared due to construction of amongst others a port just up drift of that area.

Appendix D: River Flooding Analysis

The main goal of the River Flooding Analysis is to define the problem and analyse the cause(s) to the problem of river flooding in Manado City. In the Analysis three factors are found that combined or on their own cause flooding in Manado. These are high discharge (flash floods), high tides (storm surge + spring tide) and hydraulic obstacles in the river. In addition to this, a small overview of the current plan and the future plans in Manado are given in the field of Flood Prevention.

Appendix E: Geotechnical Analysis

An overview of the geotechnical situation in and around Manado City.

Appendix F: Construction Management Analyses

The clear Vision and Mission of Kota Manado has to be implemented in the daily management of the city. New civil engineering constructions are needed to secure the safety of the people, and to improve the attractiveness of the city. This can only be accomplished when the citizens support the opinion of the local government, today and tomorrow. But how is this possible when the government takes all the decisions without the involvement of its citizens and private parties. In this appendix all answers are elaborated by an analysis of the current situation and recommendations for the future.

Appendix G: Coastal protection

The coastal protection report contains recommendations and solutions regarding the protection of the shoreline. A good and durable design has made, regarding the southern part of the shoreline, which can be well recommended to use at similar problem areas. Recommendations are given upon construction of future land reclamation. The largest part of this document contains the possible solutions to protect the northern part of the coast. Several solutions are being presented, like mangroves, a breakwater or just the use of sandbags. Finally a multi criteria analysis is made and recommendations are given.

Appendix H: Flood Prevention Plan

The Flood Prevention Plan (FPP) consist out of three distinct part, knowing: Short term, Midterm, Long term. During the analysis the current problems are analysed and the most urgent parts in the river that need attention are pointed out . These short term (5 years) problems are then followed by the midterm (10 years) and long term (25 years) problem definition. Short term being characterized by concrete solutions that can be taken to the designing stage immediately. The other extreme is long term planning. Here the idea is to think abstract and sketch multiple scenarios to be foreseen in the future. Midterm being a combination of the two. This makes suspected and unsuspected changes in natural, economic etc. climates better to manage. The adaptation to these changes can be placed in a Master plan, created out of the three terms. This plan should be updated every 10 years to the prevailing circumstances that are valid in that period and are learned from past experience.

Appendix I: Manado Beach

Manado Beach would be an extra recreational in the city of Manado. At this moment there are almost no recreational, or ‘green’, areas in the city. People, mainly the teenagers, have no place to hang out, besides the shopping malls, and also tourist are not attracted to go to the city shoreline. That can be improved by creating a beach in front of Manado. The best location will be near the Megamall shopping area. The coastal strip is ideal to make a boulevard along the beach for drinking and eating. Also technically it is the best possible location because of the limited depth, compared to other spots. This document contains both the social and the technical aspects to get a good insight into the possibilities and opportunities of this concept.

Appendix J: Garbage Plan

The city of Manado is one that has several distinct problems. Next to coastal, flooding and traffic problems the city has a big problem with the handling of garbage. There are three kind of sub problems, garbage on the street, garbage in the river and the handling of garbage from households to incinerator or process plant. The possible solutions given contain concrete solutions that can be directly implemented and the once that need more thinking and different disciplines to find a solution. A abstract solutions that needs more research and different disciplines is the one where peoples attitude and mindset must be changed in a way that they become more aware of handling garbage. By improving this the other solutions have more effect and reach their full potential.

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Appendix A
Problem Definition

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1 Problem definition

Opportunities to improve systems and solve civil technical challenges can be found all over the world. Nowadays the city of Manado is functioning well. As with all prospered major cities, the city of Manado looks at his past and future. The city evaluates where they are now and where they will be in several years. Developments goes hand-in-hand with new challenges. These challenges also can find their origin in the past. Objectives for this project are already stated up front in the Terms of Reference. The objectives will be reviewed and defined in this section of the report.

Two of the challenges of Manado will be investigated. In the year of 2003 a major flood occurred in the city, causing a great damage to the city with many casualties. Risk of flooding is still present today. Secondly a challenge at the border of the city is chosen. The coastline of Manado suffers at specific locations from erosion, possibly caused by early development of newly reclaimed land. Following these two subjects will be explained, also the boundaries of the study will be defined.

1.1 Flooding

Threats of flooding can be found both in the outland (sea) as in the inland of Minahasa, causing floods within the city of Manado. Outland threats are like tsunami's caused by seismic activities. Also high tights and storm conditions can cause a flooding. These threats occur few times a year. The threats from the inland occur more frequent. During raining season a great amount of water has to be transported to the seas. When the cities rivers can't cope with this high discharge demand, overflowing and floods are a severe risk. Comparing the time it is raining season and the few times floods are caused by an outland threat, the inland threats are the most important to solve at this moment. By this reason the analysis is focused on inland threats, namely the rivers in Manado city and more inland in Minahasa.

First surveys and contacts gave us the following points of attentions toward the flooding challenges;

- The cities rivers are polluted with garbage (e.g. bags, sacs, plastic). The pollution increases hydraulic resistance and thereby reduces the discharge capacity of the rivers in question. Litter is mainly found within the borders of the city, starting at Kairagi Bridge. Outside the city of Manado there is no litter found worth to mention, but here there is another pollution. The "Eceng Gondok" plant crowed the inland rivers around Tondano. By collection of Eceng Gondok upstream, the problem is partly solved. Upstream the plants also cause a great sedimentation in the lake of Tondano. In times of rain the lake serves as a buffer to reduce the peak in the high discharge. Due to sedimentation, caused by the Eceng Gondok, the capacity of the rain buffer is reducing. Solutions need to be found on these two sources, which reduce the discharge of the rivers. Question that arise are like; Is it possible to reduce or even avoid river pollution? Can the pollution be collected? What is the best way to collect it?
- Over time the city of Manado has expended and land within the cities border is reused. New purposes are assigned to land pieces. Not all of this development has taken place for the greater good. Within the cities rivers became smaller, because villagers begun to build on the banks of the rivers. Thereby moving the rivers boundary, creating less space for the river flow. Besides narrowing the river, villagers also use the river for fishery. Using fish cages they catch fish, but also increase the hydraulic resistance. Questions which arise are like; Is it possible to increase the space for the river looking at its cross section and the current construction? Are there other solutions for the fish cages at Ternate? Can a river bypass solves some issues?

1.2 Coastal

To investigate the erosion problems along the shoreline of Manado, the current coastal defense projects, which are partly under construction, will be examined. Especially the parts which are eroded intensively. Therefore the project on the South side of Manado will be elaborated.

The erosion problem over here is intense. Roads along the shore are in danger, because the land in front of the road is eroded heavily. To protect this road, a coastal defense structure is constructed. Thus as a part of the overall erosion problems, the durability of this project will be investigated as well as the source of the erosion (structural and episodic erosion). The main question about the durability of this protection structure is; Is the protection deep enough into the water? The protection can be too shallow, because with the use of local rubble or locally made concrete (making a vertical wall on a shallow foundation) it is usually not deep enough. When a protection is not deep enough the erosion still continuous. Not with an average rate of 1m/year, but 10m/10year. Also groundwater flow which can causes soil transport and consequently threatening of the stability of the protection will be examined. So to prevent this problems the existing coastal protection will be investigated.

The reclaimed areas along the Manado coastline have had an effect on the surrounding area. By creating new land into the sea, the current pattern and the erosion-sedimentation pattern will change. Consequently it has an influence on the erosion along the shoreline, but most likely also near and around the 'Bunaken'. These are two areas which experience negative or positive effects, though there might be more areas that experience problems, for instance the effects on the outflow of the river. Looking into the erosion problems, the influence of the land reclamation and what areas are affected by the reclaimed areas will also be taken into account.

Once the influence of existing land reclamation is examined, one can start investigating the possibility of new land reclamation. This depends on the outcome of the previous part. Although, there will still be an investigation into the possibility, the shape and location of the possible land reclamation. Also the effects of those new reclamations will be examined.

Not only the South side of Manado suffers erosion, also the North side of Manado suffers severe erosion problems. The problems in some areas are so bad, that the coastline retreated and consequently the coastline retreated so far, that some villages disappeared into the sea. Therefore the source of the erosion problems and also the reason that those specific locations are being eroded have to be investigated. An promising approach to examine the erosion is to look at the past erosion-deposition pattern but also the present pattern.

Another interesting problem is a sedimentation problem inside a port in the neighbourhood of Tonkeina. The problem is the sedimentation in the port, which is probably caused by a wrong design. The construction of the port is already adjusted to let the sediment flow outwards of the basin. However the situation is not yet ideal. To look at this problem, connections and relations to the adjacent coast can be made. For instance comparable sedimentation-erosion patterns, current patterns and wave attack. This could be interesting for investigating the erosion of the whole coastline. Another interesting thing besides the effect of erosion, is the influence on the Mangrove forest and coral in the vicinity of this port.

1.3 Construction Management

Everyone is different and therefore everybody needs a different approach to achieve the common goal. In the world of construction management, an answer to the question which approach is the best, cannot be given by a simple phrase, based on hard data. Besides the fact that an approach is not good or bad, it is inappropriate to talk about problems and solutions. Therefore it will be an investigation about the current strategies and methods. With a lot of meetings and small talks a proper view can be realised to give recommendations about the process the accomplish a civil engineering construction.

This research will contain several aspects related to the construction management. In the end it is an on-going process of several disciplines that together will result in a path from problem, through solution to completion. The distinction between the disciplines is sometimes hard to define, they mostly interact with each other. In the following paragraphs these disciplines are elaborated descending, starting with the most leading aspect.

Process management is the relevance of knowledge, skills, tools, techniques and systems to define, visualize, measure, control, report and improve processes with the goal to meet customer requirements profitably. It is known that the process of construction is different in every country. It is arrogant to say that the Dutch way is better so by enlighten the governmental agencies with the alternatives it is up to them to decided what they might implement in their methods.

Project management is the discipline of planning, organizing, securing, and managing resources to achieve specific goals. A project is a temporary endeavor with a defined beginning and end (usually time-constrained, and often constrained by funding or deliverables), undertaken to meet unique goals and objectives, typically to bring about beneficial change or added value. The primary challenge of project management is to achieve all of the project goals and objectives while honoring the preconceived constraints. Typical constraints are scope, time, and budget. The secondary—and more ambitious—challenge is to optimize the allocation and integrate the inputs necessary to meet pre-defined objectives.

Legal and Governance is a topic that consist of laws and regulations, but also about business agreements between public and private companies. The legal part is, besides the safety rules of a construction site also, the rules of engagement. Who is responsible for the environment, design, procurement and any default during and after the construction. The governance part has to do with several contract in the market. In most cases a single company is not able to complete a total project by itself and therefore a combination is very useful. The network of a governmental agency is highly important to form certain contract and distribution of the profit.

Financial Engineering is the part which will contribute to the feasibility study of every single project. What is the best solution to raise funds or to make use of economical benefits. The local and national interests, netto present value and revenues will give a well based argument to decide wether ar project is viable or not. Eventually all the topics above will have an influence on this section.

Appendix B
Field trip Manado

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1 Introduction

On the 24th of august a fieldtrip around Manado was one of the planned activities. This fieldtrip was under the guidance of local English speaking people. The fieldtrip let us see some of the structures that were already under construction, in this case it was a seawall that was replacing an old one. After this we continued our trip to see the rest of the coast and identify what other structures are used in the Manado coastal area. Also we looked at some of water discharge points where the river meets the sea.

After the lunch we took a look at some of the rivers and their conditions. This we'd done to give a picture to our investigation into the flooding problems in Manado. A lot of the rivers are poorly maintained as will be show in this report.

2 Visited locations

During the fieldtrip some locations has been visited, on the map underneath the locations are highlighted. There has been made a distinction between two visit purposes, one being coastal and the other is inland flooding.
The sites were chosen on forehand on their project relevance, most of the coastal areas that has been visited set a good example of the typical coastal defences in Manado. Some showed some weak spots in the coastal defence of Manado.

Figure 1: Visited areas

The other ones are directly related to our investigation concerning the flooding problems. There are just a few, because the day was already coming to a close. According to our guide this already gave a good impression of the general state of rivers and canals in the Manado City area.

3 Coastal Area Visits

The coastal area in Manado shows a divers profile with a lot of variation in coastal defence types. The one thing that is a commonality between all of them is the use of basalt rock. This is freely available in the mountains, because there's so much volcanic activity in the surroundings that eventually produce very tough basalt rock.

3.1 Site 1: T-Groins

The description starts from the most southern point of the Manado coast. This coast shows the most structures of all of the Manado coast. This side of the coast there are some robust structures to protect the land from wave attacks and strong currents. In the first picture a T-head breakwater is visible.

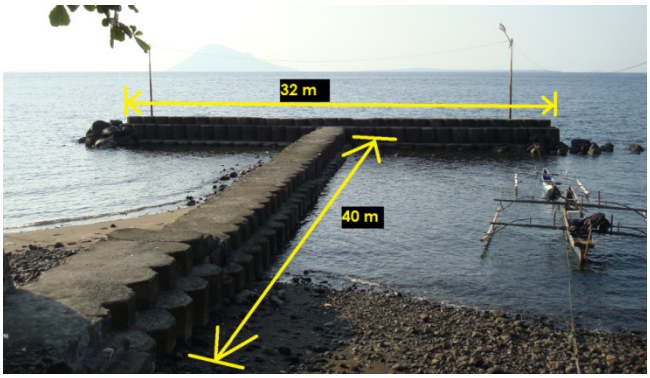

Figure 2: T-head groyne

It has formidable sizes and without further investigation they seem to do their protecting job. There are no strange patterns of sand at the surface, from observations there is some sedimentation in the left corner of the breakwater. Some aerial photos give a better overview of the situation. All of the coastal sedimentation and erosion is still within limits of the coast. But some could say that the breakwater next to it has a different sedimentation build up pattern than the right one. See how the left side has accreted more than left and with the breakwater in the picture this is different.

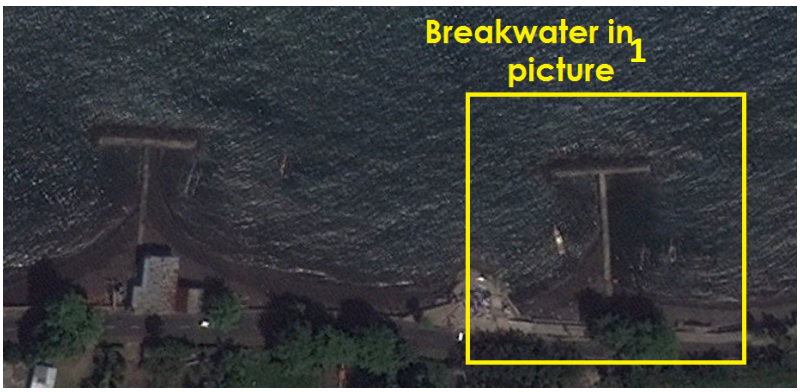

Figure 3; Areal view breakwater

3.2 Site 2: Seawall

The Second site that has been visited was a project were they where constructing a new seawall to replace the old one. This old one was partially collapsed and also the design didn't fit the hydraulic requirements for a storm. In this case the seawall can also be looked at when workers are building it, showing some of the working methods that are common to Indonesia.

Seawall under construction

The project consisted of building 150 m seawall. From the 150 m already there was 50 m constructed and 30m was under construction in different stages. For the construction of the wall minimal use was made of electrical equipment like diggers of other power tools. A good example was shown by the way the concrete is compacted just by hand, with a stick the poked in the just poured cement, and not with the use of a vibrating needle. Also the use of measurement tools is very limited.

In the first picture working men are building the foundation pillars for the seawall. As can be seen this goes in a really basic fashion and problems are solved with crude 'workingmen solutions'. If one looks at the picture very precise, one that to prevent the concrete from leaking out of the cracks of the stonewall they used paper cement bags. Something that that could bring of some questions in whether this contributes to the stability of the seawall core.

Figure 4: Protection under construction

The following picture visualizes the constructing of the crown wall on top of the structure above. The crown wall is made of reinforced concrete with connection to the core wall every 5 meters. The crown wall is shaped like a funnel so the wave energy is diverted away from the wall. This makes sense because a lot of waves will hit here and reach up to the crown, the front is made quite smooth and steep so one has a fair change of sloshing waves that run up all way to the crown wall area.

Figure 5: Wall under construction

Finished seawall

As a final part of this site visit a few pictures of the completed wall are shown. The finished wall looks quite well constructed, there are hardly any flaws left in the seawall. In front of the completed seawall there are also some rocks place the dampen the waves. These blocks are in the class of 70-100 cm, this seems reasonable if waves of up to 4-5 meters can occur at some spots along the coast.

Figure 6: Final protection

As an extra measure to prevent too much water entering the land there is an overflow drainage. This drainage consist of a deep rather small gutter that is situated on 1 m from the edge and every 30 meters there is a big drain pipe that returns it to sea, this can only be done in the moment the wave is retreating. Something hopefully designed in such a way that it bears in mind that there is enough time between wave cycles so the one wave doesn't enforce another incoming wave.

3.3 Site 3: Boulevard area seawall, rubble mount revetment

The following site gave a good impression of how the most coastal parts look like in de Manado (central) area. It's already stated that big boulders are readily available from the inland and this is by far the cheapest coastal protection. This site was situated on one of the pieces of reclaimed land that are spread across a large part of the Manado Coast.

Figure 7: Rubble mound protection

The Stones, as understood from dr. Peter Assa (Mr. Assa also designed the Seawall at site #2), does not have a gradation. A lot of stones vary in size from just within human lifting capacity (around 30/40 kg) until stones the size of a small car. You may ask yourself 'is vulnerable to damage?' because there is a risk of outwash of smaller rocks from between the large ones.

Also a keen idea is that of the Icelandic type breakwaters that also consist of an unsorted abundance of rock that will settle itself in a stable shape after some time. The big question here is the amount of stones enough to fuel such an stabilization.

3.4 Site 4: Inlet for fishermen

The next site's first impression is that it's a shelter for the local fishermen. The fishermen uses this protected sea inlet to store their boats and more equipment for fishing. The place was actually first designed to be a beach for recreational purposes. This is still possible say that the beach line is very narrow and consist of a mix of pebbles and coarse sand. So this might be not so well designed as a beach, it serves its purpose as fishermen inlet well.

The concept of a rubble mount breakwater as seen earlier is also used here. A mix (probably unsorted) of basalt boulders is used to protect the coastline from any wave attack from the sea. In the following picture you see the coast in the state of it. If one looks carefully one can observe that some of the large boulders have slide down from the revetment.

Figure 8: Fishermen inlet

This is probably because of storm damage but without further investigation this can't be confirmed. It is a fact that the outstretching breakwater seen on the upper side of the picture was build at a later moment than this coastal protection. So if the coastal revetment wasn't designed properly it now is sheltered behind this breakwater. The breakwater doesn't seem to show any flaws so also this part of the Manado coast looks to hold up to the storm conditions.

3.5 Site 5: Semi-protected river outflow

Manado has a 5 main outflows that belong to the rivers that have their source in the Minahasa Area. The smallest of the rivers has been visited because this shows the most problems (looks really shallow in comparison to the big river outlet at the North of the City). This first picture is taken from Google earth and show an aerial view of the outlet.

Figure 9: Aerial view river Sario

From this picture it can be seen that the seaside mouth of the outflow is clogged up with sand, probably being bed material from the river. Out of the point of a coastal engineer this blockage can be turned useful in the protection of the coast, the sandbank forms a natural boundary to keep waves from penetrating the river. If one looks just at the effectiveness of the river as an outlet the sandbank forming in front of the river outlet in this case presents a serious hydraulic obstacle that prevents the water from flowing out freely. In this case probably a good maintenance scheme could already up the discharge capacity by several percentages.

3.6 Site 6: Manado Harbour

The last of the coastal site that were visited was the Manado city harbour. This harbour is in the most northern point of the Manado city area. In the area a lot of places are put somewhat higher than their surroundings to accommodate the somewhat larger ships that make port in the harbour of Manado.

Something you can also see is that the harbour consist of a lot of separate build projects. The harbour has no consistent coastal defence line. A fair question here to ask oneself if all these connecting structures from one to another defence structure are sufficient or do they create weak points. This is merely an observation so no research can confirm this suspicion.

The harbour main purpose seems to be that of fishery port. Every day fishing boats deliver their fresh caught merchandise and sell them to the merchants in the port. The sub purpose of the harbour is that of transportation. In the harbour area there are some areas where ferries and liners lay, the service take people from and to some neighbouring islands.

Some photos of the harbour

Figure 10: Harbour

Figure 11: Harbour

4 Flooding Area Visits

Next to a coastal investigation trip some areas more inland have also been visited. Our guide put out some location where the river can be observed proper and which also give an overview of how, if one come to look at any random river in Manado, the general conditions of the rivers are.

In this case, some photos have been taken at different times, also when the river discharge was higher, in this case rainfall in the mountains. Also one can see the disastrous effects of garbage in the river. This is all washed out into the sea at moments of high discharge. More on this in the description of the sites.

4.1 Site 1: River Discharge point

The first site visited is actually the same as on concerning the coastal area. In this case a closer look is given to the outlet as an endpoint of the river and also some pictures are taken of the 2 rivers behind it coming together.

For this point a series of pictures is also taken when there is higher discharge visible. This gives a good idea of how the river changes when handling different hydraulic conditions. In the first picture the normal condition is shown, there is a low discharge and large dry areas are visible.

Figure 12: River mouth low tide

Half of the effective width under the bridge is clogged up with sand. If this is done intentionally can't be said for sure but knowing they experience lots of trouble with water when there is a high discharge it does seem wise to keep this outlet so clogged up. At times when there is a low discharge this also can be an advantage in keeping the water flowing at a certain rate. This however stays rather an ineffective and dangerous setup when there are large watersheds heading for the city from the mountains and lake Tondano.
At times with high discharges the site changes a lot from the above described situation. The complete width of the river is used, and even this was not such a heavy shower the water gives fairly high surface speed.

Figure 13: River mouth spring tide

Together with the finding that more water at a higher speed flows into the ocean, also the problem the city faces with – in particularly plastic – garbage that is thrown in the river by the people living in the vicinity of it. This garbage has a free entree to the sea and is not kept from entering by any means. This is a big problem that the city is fighting the last several years. Especially the Bunaken as a coral are deathly wounded by the litter of the city. Also the neighbouring coast and island experience very large quantities of rubbish littering their shores.
This litter problem however important is treated in another report specially dedicated to this problem.

4.2 Site 2: Hydraulic obstacle, Bridge

The second site visited is one of the many bridges that are build over and partly also in the river. Already one can see in a blink of an eye that there is a lot of junk stuck behind the middle pillars that makes it harder for the river to flow through. In the picture one can see the bridge from the upstream side.

Figure 14: Hydraulic obstacle

In the front of the picture one can see the result of long term sedimentation of junk and sediment, the place is just started to bloom full of grass and other river plants. This in its turn makes it harder for the river to flush clean when there's a large watershed.

Also at this point a picture is taken during such a moment. The watershed is not that long during shower but of a brief one. Already it can be seen that the water discharge level and flow speed have increased dramatically. To compare them both photos are taken at the same location but under different circumstances.

Figure 15; Upstream of bridge (L), downstream of bridge (R)

It can be seen that even a small rain shower fills up a large part of the river. In this picture there is an estimate level rise of around 0,5 m. which is quite high considering when there is more water to be expected that the low walls aren't high enough to control the river.
This are just 2 examples that give an overview of how the river system – especially – in the City part looks like and also see that some area are very sensitive to flooding to happen and flooding that already happened.

5 Shoreline Molas

In the Northern part of Manado a district called Molas suffers from erosion. A part of the shoreline experience these kind of problems. An interesting occurrence, which is relevant for the research into coastal problems.

5.1 Site 1: Shoreline Molas

Near the coastline of Molas an area of 500m by 150m has eroded gradually approximately 10 years ago. This stretch of coast erodes progressively and is still eroding. In the image below the eroded area has been depicted roughly.

Figure 16: eroded area molas

Inside this red marked area, there used to be a village. During this field trip a local, who used to live in this village, showed the eroded area and mentioned some relevant facts. In this area, however, there were no mangroves anymore because the village was built there. This, as well, might be a contribution to the problem.

Within the same period of the erosion, a port was built just updrift of the eroded area. This could be one of the causes of erosion, because of the fact that sedimentation transport is towards the North. The harbour, thus, possibly blocks this sediment transport. If the coastline of Molas is in an equilibrium, that means that erosion of the coastline 'normally' will be compensated by the sedimentation, this will lead to serious damage. Without this sedimentation, due to the blockage of the harbour, there's only erosion. Another reason could be a change in current pattern due to the construction of the port but also construction of the reclamation along the shore of Manado could have a contribution. Due to the current change, for instance changing into a gyre which transports the sediment seawards, the erosion could have started.

Another possibility could be erosion due to wave attack. Although this seems not very realistic, because of the limited fetch and the area is quite sheltered, one heavy storm of storm season could be an explanation for the erosion.
South of the eroded area a river runs into the sea. An interesting phenomena is the fact that rivers usually transports sediment towards the sea. Taken that into account one could suspect that the erosion will be, maybe partly, avoided. However, this is not the case and thus an interesting phenomenon to investigate, if possible.
The following image will visualize the erosion and what use to be land, now has become water.

Figure 17: Eroded beach

According to some areal images of the past and present, the erosion did not really continue. The magnitude of the eroded area stayed more or less constant. A remark on that can be made, looking at the image below. The area around this palm tree is still eroding, so that means that there is still erosion going on. The only indistinctness is the reason of the erosion, namely the sediment transport, change in current pattern or storm wave attack causing the erosion still going on.

Appendix C
Coastal Analysis

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List of figures

1 Coastal problem

1.1 Introduction

Before analysing the entire coastline of Manado, first some information will be given about the area. The city of Manado lies in a bay, so there's no straight coastline. Instead it has a shape like a bowl. In the Northwest of Manado some islands are present, which block incoming waves from the North. Figure 1 represents that clearly. Also the dominant direction of the current is visible depicted as a red line.

Figure 1: Coastline Manado with current direction

The south of Manado faces the open sea and has the longest fetch, given that the dominant direction is southeast. In this area the grain size is pretty large (gravel), which suggest heavy wave attack. The southern shoreline faces a lot of erosion, causing danger to the adjacent roads. The central coastline similarly experiences high waves during storm season, therefor the land reclamations are protected with rubble mound. The reclamation area itself does not encounter serious troubles, but it creates problems to the surrounding area. Finally the northern part of the coastline is very muddy, which do suggest little wave attack. The presence of mangroves clarifies this too. A problem in this area is the erosion, causing the coastline to retreat. In appendix B, the different aspects of the shoreline can be found as well. This three main, previously described problems, depicted in **Error! Reference source not found.** will be analysed.

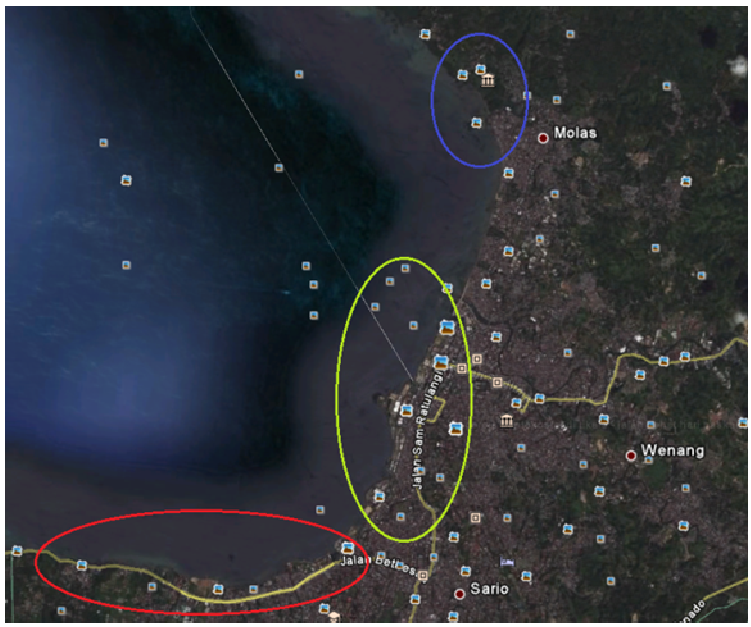


Figure 2: Three main parts of the coastline

1.2 Northern part of the shoreline Molas

Near Molas, a stretch of coastline has eroded heavily. The eroded area consists of a 500m long and 150m wide region. This erosion started approximately in the year of 1999 and slowly eroded the whole area. At the same time or few years before this (approximately 5-10 years ago from today, say between 2000 and 2005), a port was expanded just up drift of the now eroded area. The fishery port was constructed around the same as the erosion started. The breakwaters were constructed two years later and several years after that they were relocated somewhat. In Figure 4 this difference is visible, the yellow lines represent the former breakwater shape.

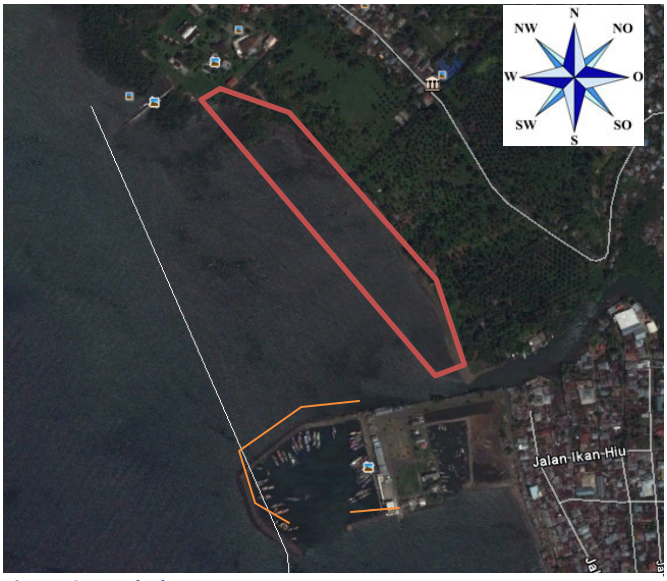


Figure 3: Eroded area

The erosion can possibly be explained by the construction of the port, but also by the major land reclamations along the shoreline of Manado. The sediment transport is from South to North along the coast. This could rapidly be obtained from the fact that larger soil grains can be found at the southern part of the Manado shoreline and mud and silts at the northern part (at Molas). Another explanation for the northward current is the different length of the fetch and the fact that the northern part of the coast is more sheltered. The difference in setup could cause the (sediment) current flowing northwards.

A different cause of erosion could be erosion due to wave attack. Although this seems not very realistic, because of the limited fetch and the area is quite sheltered, heavy storms could be an explanation for the erosion.


Figure 4: Difference in breakwaters

Another interesting thing is the fact that north of the eroded area, a mangrove forest is located. That could suggest that, near the eroded area, there used to be a mangrove forest too. Because people built a village over there, the mangroves had to be cut down. This means there was no natural protection in front of the village any longer. Assuming that the village was not suffering any problems before the reclamation area was constructed, the lack of mangroves perchance weakened the 'erosion resistance'.

The port lies south of the eroded area, thus the sediment will be blocked by the port. But not the port alone may be responsible, the large reclaimed area can also have a large contribution. When there is still a sediment transport rate near Molas (eroded area), the coast will indeed erode. The fact that a river is located just North of the port and transporting sediment towards the sea, but does not accrete that area, says a lot about the sediment transport rate near Molas. On the other side, there might be another explanation, for instance a current pattern that directs the sediment seawards and don't give the sediment the possibility to settle near the river mouth.

The erosion started approximately around 1999, at the same time as the reclamation started. This reclamation and probably also the port diverted the current pattern as such, that this also could be an explanation for the erosion. When assuming this, an occurrence of a gyre north of the port can be a reasonable explanation. But whether the port or the whole reclamation along the coast is responsible for this phenomenon is not entirely clear.

Although no large scale erosion is visible, as can be seen from the appendix: 'aerial views', in which the coastline stays more or less on the same position. The following images visualises that an area of 80m x 150m has completely eroded, though, since 2003. From this figures some channels at the northern part of the eroded area are (hardly) visible. This would suggest a kind of eddy developed behind the fishery port.

So considering all the possible causes of erosion, the change in current pattern seems to be the best explanation. The change in currents can be explained by the land reclamation or the expansion of the port. The fact that the port is blocking the sediment transport is not valid, because the port does not catch any sediment. It's not get any shallower over time.

Figure 5: Shoreline 2003

Figure 6: Shoreline 2009

1.3 Influence Land Reclamation

A large part of the shoreline of Manado consists of land reclamation. Twenty-five years ago the shoreline still consisted of a sandy beach, with houses on the waterside. That changed about twenty years ago when they built a boulevard road with a length of 4km along the shore of Manado. In front of that road they built a protection involving a vertical wall.

In 1996, the government decided to expand Manado City seawards, because there was a need for land. By that they created an opportunity for investors to develop this area for business and trade. From that year the land reclamation along the coast grew and slowly reclaimed almost the entire area along the shore. Nowadays they still are expanding into the sea, although it has become less.

Figure 7: Reclaimed areas

The total reclaimed area until 2009 was approximately 67 acres. **Error! Reference source not found.** represents the area that has being reclaimed. A remarkable thing is the fact that reclamation is only applied on shallow areas in front of the coast. This is one of the reasons that not the entire area along the coast is reclaimed (yet).

The reclaimed area consists of local gathered material. The sand and protection material used, is gained from a local quarry. It takes about an hour drive from the sea to the quarry. To construct the reclamation area, no real gradation of material is used. The coastal protection stones are randomly placed and stones with different sizes, though large ones, are used. When analysing the protection stones, one would suggest that the protection is over dimensioned. As stated before, the stones seem to be picked randomly, transported and dumped along the coast. Figure 8 represents the heavy coastal protection. Altogether, this protection seems to be able to resist heavy storms and thus is designed as a good protection.

Figure 8: Coastal protection

The reclaimed area as such has no detectable coastal problems. The problem is that the reclaimed area causes indirectly a lot of trouble to the surrounding area. By reclaiming land into the sea, it changes the coastal bathymetry. This change in bathymetry consequently causes a change in current pattern along the shoreline of Manado. A different current pattern can cause an altered sedimentation-erosion pattern, which has led to some serious erosion (like the one in Molas as described previously), but this is not the only negative side effect it has. The change in current pattern has led to a flow towards the 'Bunaken' coral reef area. Initially this seems like no harm will be done, but the opposite is true. The streaming towards 'Bunaken' caries a lot of sediment, dust and garbage and killing a lot of fish and coral. So the creation of new land has a lot of influence on the surrounding area, causing down drift erosion and pollution of coral reefs.

1.4 Malalayang Area

In the South of Manado, at the shoreline of district Malalayang, erosion is quite a big problem. At the south side of Manado, soil along the roads is eroding and these roads are in danger. When nothing will be done to overcome this problem, the road will disappear eventually. In Figure 12 and Figure 11 (images from 2003 and 2009) the erosion along the coast is clearly visible.

Figure 9: Erosion along the road

The eroded area in the South is very vulnerable, because this shoreline faces the open sea. Areas more to the North are more sheltered by the 'Bunaken' islands more or less shielding the rest of the coastline. The southern coastline encounters a quite long fetch, which can result in heavy wave attack during a storm. The sediment transport rate is very low, so that means that the erosion is mainly caused by the wave attack. Although there are some T-head groynes present at the South side of the eroded part, historical images do not show any blockage of sediment.

To overcome the erosion problem, the city of Manado already started a project to protect the shoreline in the south. The design had to fulfil some special demands like creating parking space, recreational space and of course a durable coastal protection. All leading to a construction with a battered wall. In Figure 10 the design is visible and it's noticeable that the wall is slightly sloping backwards.

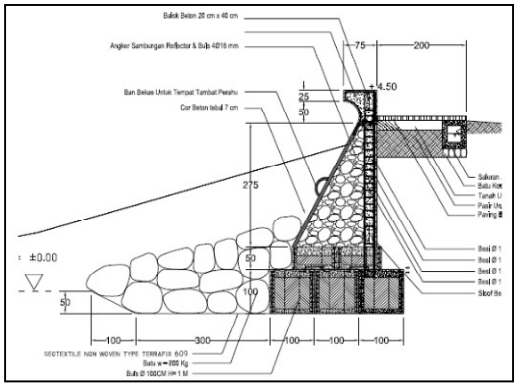


Figure 10: Design protection wall

This sloping backward is good for stability of the construction, because it's less likely that the wall turns over when scour is occurring in front of the wall than in case of a vertical wall experiencing scour. In the appendix calculation of the stability of the protection is added, which was already made by the designing government.

In this calculation overturning moments and forces, soil pressures, sea conditions, stability against sliding and minimum width of the foundation are processed. The final conclusion of this report presents a positive horizontal stability. Reading this report gives the conclusion it is a stable construction and good design.

Figure 12: Coastline 2003

Figure 11: Coastline 2009

Some additional measures are taken, to avoid several failure modes. One measure is taken to avoid the danger of scour due to wave attack at the toe of the protection. The toe protection is to constructed out of piles and stones, protecting against scour and assuring its shallow foundation. From detailed design drawings, it is also noticeable that geotextile is used under the toe protection. This will also improve the scour protection. Another special measure is the construction of the crown structure. Because of the backwards inclining wall, overtopping can occur and appear more often than in case of a vertical wall. With the recreational area and the road directly behind / on to top of the construction it is not desired to have water splashing over the wall. The crown structure prevents the overtopping. Also a drainage structure is constructed to prevent the ground from washing away behind the wall in case of water flowing down during heavy storms or rainfall. The drainage system directs the water, through channels by means of a hard structure, into the sea. So altogether, this protection structure seems to be well designed.

Figure 13: Impression coastal protection structure

1.5 Conclusion

The coastal analysis part is divided in three main parts. One can find that some parts need to be improved, where other parts need no improvement at all. The southern part of the coastline of Manado is already under construction and the sea defence will be improved. Through the stability report, it can be stated that the design is durable. So a possible recommendation is to use this structure for other eroded coastal areas, which suffer the same problem. This means that no further investigation will be done concerning this structure.

The reclamation area along the coast of Manado does not suffer from any problems, the sea defence actually is a little bit over dimensioned. Nevertheless, the reclamation area does cause a lot of (erosion) problems to the surrounding areas. The influence of creating new land is quite big and causing erosion down drift and pollution of National diving areas, probably because of the diverted currents. When considering new land reclamation, one should, thus, first investigate the side effects, also on other nearby areas, before constructing the new land.

The northern part of the shoreline, near Molas, erosion is potential problematic. Caused by constructing the fishery port or because of the land reclamation, a large stretch of coast has eroded. The modified current pattern along the coast is the most obvious explanation of the erosion. Therefore a research into the best solution, of the problem along the northern shoreline, has the most priority. Also because the rest of the coastline is not really in danger and need no real improvement at the moment. The focus, for finding solutions for coastal problems, should lie on the northern part of the shoreline.

Appendix 1: Aerial images

Molas area

Overview

Figure 14: Satellite view 2003

Figure 15: Satellite view 2006

Figure 16: Satellite view 2009

Figure 17: Satellite view 2011

Detailed shoreline change

Figure 18: Situation 2003

Figure 19: Situation 2009

Malalayang area

Overview

Figure 20: Satellite view 2004

Figure 21: Satellite view 2009

Appendix 2: Stability Calculation

Malalayang coastal defense

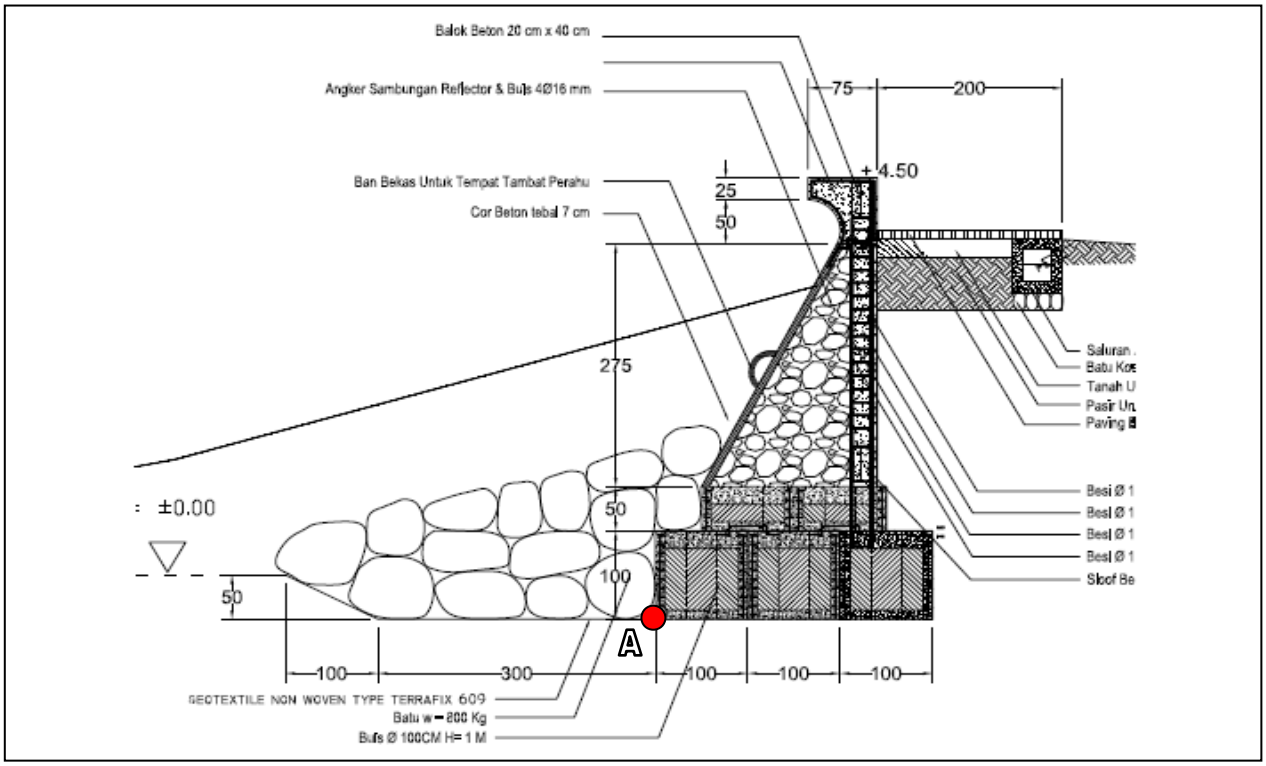


Figure 3 Cuts Across Malalayang Beach Seawall Construction

DATA

	db	=	2,60 m	→	γ_w	=	1,03 t/m^3
→	Hb	=	2,20 m				
	T	=	6 det	→	ds	=	1,00 m

Calculation of solution:

Forces and overturning moments on the Seawall.

$\rightarrow$ $h_c = 0{,}78\ H_b = 0{,}78 \cdot 2{,}20 = 1{,}716$ m.

$\rightarrow$ $P_m = \frac{\gamma_w . c^2}{2\delta} = \frac{\gamma_w \cdot d_b}{2} = \frac{1{,}03 \cdot 2{,}60}{2} = 1{,}339$ tm/m

$\rightarrow$ $R_m = P_m . h_c = 1{,}339 \cdot 1{,}716 = 2{,}298$ t/m^2

$\rightarrow$ $M_m = R_m (d_s + \frac{h_c}{2}) = 2{,}298 \cdot (1{,}00 + \frac{1{,}716}{2}) = 4{,}296$ tm/m

$\rightarrow$ $R_s = \frac{\gamma_w (ds+hc)^2}{2} = 1{,}03 \frac{(1{,}00+1{,}716)}{2} = 3{,}799$ t/m'

$\rightarrow$ $M_s = R_s \frac{(ds+he)}{3} = 3{,}799 \frac{(1{,}00+1{,}716)}{3} = 3{,}439$ tm/m

Overall rotational force and internal moment.

$R_t = R_m + R_s = 2{,}298 + 3{,}799 = 6{,}097$ t/m'

$M_t = M_m + M_s = 4{,}269 + 3{,}439 = 7{,}709$ tm/m

Segment Weight (per meter)

- Weight segment + Weight fill, h = 1.0 m
  - $\rightarrow$ Volume Segment (Concrete Blanket K-225) = 0.298 m ^{2} (V_B)
  - $\rightarrow$ Volume Contents Segment (Sand) = 0.371 m^2 (V_I)
  - $\rightarrow$ Closing volume Segment K-175 = 0.159 m^3 (V_p)

$\therefore$ Total Weight Segment

$W_I = V_B . \gamma_c + V_i . \gamma_{Ps} + V_P . \gamma_c$

$= 0.298.2400 + 0, 371.1600 + 0.1\ 59.2200$

$= 1659.6$ kg $= 1.659$ ton

- Weight Segment four 0.5 X 1.00 m.
  - $\rightarrow$ Volume Segment (Concrete Blanket K-225) = 0.164 m ^{2} (V_B)
  - $\rightarrow$ Volume Contents Segment (Sand) = 0.117 m ^{2} (V_I)
  - $\rightarrow$ Closing volume Segment K-175 = 0.175 m ^{3} (V_p)

$\therefore$ Total Weight Segment

$W_{II} = 0.164.2400 + 0, 117.1600 + 0, 175.2200$

$= 968.34$ kg $= 0.9683$ ton

- Concrete Weight Crown wall K-225

$W_C = 0.438.2400$

$= 1050$ kg $= 1.05$ tons

- Western Concrete Wave Reflector

Volume Reflector $= 3.240$ m^3 $\rightarrow$ $Y_{(rock)} = 1800$ Kg / m^3

$W_R = 3.240 \times 1800 = 5832$ Kg

$= 5.832$ Ton

- Western Land

  The volume of soil above the foundation = 0.315 m^3

  $Y_{(soil)}$ = 1420 Kg / m^3

  Weight Total Land in Upper Seawall

  W = 0.315 x 1420 = 447.3 Kg

  = 0.4473 Tons

- West Sidewalk

  Block Paving volume = 0.200 m^3

  $Y_{(Paving\ block)}$ = 2000 Kg / m^3

  Sand Volume Urug = 0.500 m^3

  $Y_{(Sand)}$ = 1600 Kg / m^3

  Empty Stone Volume = 0.1 m^3

  $Y_{(Sand)}$ = 1700 Kg / m^3

  Sidewalks Total Weight

  W_T = 1370 Kg = 1.37 Tons

- Imposition of Western Segment

  $W_1 = W_2 = W_3 = \mathbf{W_I}$ = 1.66 tons

  $W_3 = W_4 = \mathbf{W_{II}}$ = 0.968 tons

  $W_6 + W_7 = \mathbf{W_R}$ = 5.832 tons

  $W_8 + W_9 + W_{10} = \mathbf{W_c}$ = 1.05 tons.

  $W_{11} + W_{12} = \mathbf{W_{Mr.}}$ = 0.4473 tons.

  $W_{13} = \mathbf{W_T}$ = 1.37 tons.

Calculate Land Carrying Capacity.

- **Land Data**

  C = 0.007

  Ø = 36.14 ^{0}

  γ_s = 1.21 t / m ^{3}

- Calculate q_u by Tersaghi

  - The formula: $q_u = 1.3.C.N_C + \gamma.D_f.Nq + 0.4.\gamma.B.N\gamma$

  where: $N_C = 46$

  $N_q = 37$

  $N_\gamma = 50$

  $D_f = 1.5$ m

  B = 3.0 m

  (Data N_c, N_q, and N_γ is taken from Figure 2.20.Soil Mechanics and Foundations by Kazuto Nakazawa & Sosrodarsono based on the value of Ø = 36.14 ^{0})

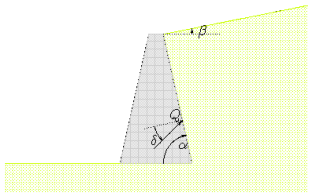
  q_u = 1.3.0.007. 46 + 1.21. 1.5. 37 + 0.4. 1.21. 3.0. 50

  = 140.17 t / m ^{2}

  Q_a = q_u / F_S → F_S = 3.0

  = 140.17 / 3

  Q_a = 46.72 t / m ^{2}



Calculate K_a by Coulomb method.

$$K_a = \frac{\sin^2(\alpha+\phi)}{\sin^2\alpha\sin(\alpha-\delta)\left[1+\sqrt{\{\sin(\phi+\delta)\sin(\phi-\beta)\}/\{\sin(\alpha-\delta)\sin(\alpha+\beta)\}}\right]^2}$$

Formula:

$$k_a = \frac{Cos^2(Ø-\theta)}{Cos^2\theta \,.\, Cos(\theta+\delta)\,.\left\{1+\sqrt{\frac{Sin(Ø+\delta)\,.\,Sin(Ø-\alpha)}{Cos(\alpha-\theta)\,.\,Cos(\theta+\delta)}}\right\}^2}$$

- When you see the sketch Imposition, then:

  a = 0

  Θ = 0

  Δ = Ø.2 / 3 = 36.14. 2 / 3 = 24,09

So that:

$$k_a = \frac{Cos^2(36{,}14-0)}{Cos^2 0\,.\,Cos(0+24{,}09)\,.\left\{1+\sqrt{\frac{Sin(36{,}14+24{,}09)\,.\,Sin(36{,}14-0)}{Cos(0-0)\,.\,Cos(0+24{,}09)}}\right\}^2}$$

$$k_a = \frac{0{,}652}{2{,}223} = 0.293 \approx 0.300$$

Calculating soil pressure on the wall.

H = 3.5 m

B = 3.0 m

q = 1

- $P_1 = \frac{\gamma_s}{2} H_{(S} H + 2h). k_a$

Where;

$h_S = q / \gamma_s = 1.0 / 1.21 = 0.826$ m

∴ $P_1 = \frac{1,21}{2} .3.5 (3.5 + 2. (0.704)).0.300$

$= 3.199$ t / m ^{3}

- Since β = δ + θ = 24.09, then

$P_{H1} = P_{1.}\text{Cos } \beta = 3.577. \text{Cos } 24.09 = 2.92$ t / m^1

$P_{V1} = P_{1.}\text{Sin } \beta = 3.577. \text{Sin } 24.09 = 1.306$ t / m^1

High Line works is:

$h_1 = \frac{H}{3} x \frac{H+3h_s}{H+2h_s} = \frac{3,5}{3} x \frac{3,5 + 3.0,704}{3,5 + 2.0,704} = 1.353$ m

$h_o = 1$ m

- $P_2 = \frac{\gamma_S}{2} x (h_{o +} 2h_{1).} k_a = \frac{1,21}{2} .(1 + 2.1,353). 0.300$

$P_2 = 0.177$ t / m '

- $P_{H2} = P_{2.}\text{Cos } 24.09 = 0323.0.912 = 0161$ t / m '

$P_{V2} = P_{2.}\text{Sin } 24.09 = 0323.0.408 = 0072$ t / m '

$h_2 = 1 / 3$ Hp $= 0333$ m

Calculation of Moment around Point A

Table 2 Calculation of Moment at point A on the building Malalayang Beach Seawall

i.	Wi ton	li	Wi. Li ton.m
1	1.66	0.5	0.82962
2	1.66	1.5	2.48886
3	1.66	2.5	4.1481
4	0.97	1	0.96834
5.	0.97	2	1.93668
6.	3.71	1:25	4.640625
7.	1.98	1875	3.7125
9.	00:45	2025	0.91125
10	00:48	2.2	1056
11	12:12	1875	0225
13	12:27	2.85	0.7759125
14	12:11	2875	0.3130875
15	1:34	3.4	4556
Σ	15:38		26.56

Analysis of stability (Stability)

$$d = \frac{\sum M_r \cdot \sum M_0}{\sum W}$$

- Condition of Sea Level at DWL

$$d = \frac{26{,}56 - (2{,}92 \cdot 1{,}35 - 0{,}16 \cdot 0{,}33 - 7{,}709)}{15{,}38}$$

$$= 1.97 \text{ m}$$

e = B / 2 - d = 3 / 2 – 1.97 = -0.474 m <3 / 6 = 0.5 m **....OK!**

- Sea Level Conditions on LLWL

$$d = \frac{26{,}56 - (2{,}92 \cdot 1{,}35 - 0{,}16 \cdot 0{,}33)}{15{,}38}$$

= 1.47 m

e = B / 2 - d = 3 / 2 – 1.47 = 0026 m <3 / 6 = 0.5 m **....OK!**

Stability against sliding.

$$F_S = \frac{\sum M_r \cdot \mu}{\sum P_H} = \frac{26{,}56 \cdot 0{,}6}{2{,}92 - 0{,}16} = 5.77 > 1.5$$ **....OK!**

Against stability Carrying Capacity

$$\left.\begin{matrix} q_1 \\ q_2 \end{matrix}\right\} = \frac{\sum W}{B}\left(1 \pm \frac{6 \cdot e}{B}\right)$$

$$= \frac{15{,}38}{3}\left(1 \pm \frac{6 \cdot 0{,}026}{3}\right)$$

q_1 = 5.39 t / m ^{2} <Q_a = 46.72 t / m ^{2} **....OK!**

q_2 = 4.85 t / m ^{2} <Q_a = 46.72 t / m ^{2} **....OK!**

Against stability Carrying Capacity

Style Uplift, $P_u = \gamma_{w.} d = 1.03.\ 2.5 = 2.575$ t / m ^{2}

F_B = 2.575.B.

$F_H = \gamma_{w.} D^2 / 2$

$= 1.03.2{,}5^2 / 2$

$= 3.218$ t / m^1

Equilibrium Style

2.575 B + R_V - W = 0

2.575 B + Rv - 15.38 = 0

Rv = 15.38-2.575 B

Moment around balance point A

M_{st} - Fb. (B / 2) + $Ph_2 * {}_2$ - ((Wi - 2.575.B) * B / 3) + MT - $Ph_1 * h_1$ = 0

26.75 - (2.575 B * B / 2) + 0.00539 - (15.38 – 2.575 B) * B / 3) + 7.709-3.95 = 0

0.4292 B ^{2} - 5.126 B + 30.370 = 0

Minimum width of foundation:

Known:

a = 0.4292

b = -5.126

c = 30.370

$$B_1 = \frac{-b \pm \sqrt{b - 4ac}}{2a}$$

$$= \frac{-(-5{,}126) \pm \sqrt{-5{,}126 - 4.0{,}429.30{,}370}}{2.30{,}370}$$

B_1 (+) = 16.28
B_1 (-) = -4.34

Horizontal Control:
Fh = μ.Rv
= 0.6.7.65
= 4.63 t / m^1

$F_E - F_H - R_H$ = 0
$P_{H1} - {}_{H2}P - F_H$ = R_H
R_H = -1.84

Conditions:
$F_{H>} R_H{}^2$
4.591> 3.415 ... .**OK!**

Appendix D

River Flooding Analysis

Contents

List of figures

1 Area description

The river flooding problem is one of the main problems that the people and government face in the city of Manado. The main river system in Manado consist of 5 big rivers that enter the city from the mountains, namely:

- Tondano River;
- Sario River;
- Bailang River;
- Malalayang River;
- Ticala river.

Not all the rivers are considered, being within areas where they pose a serious danger to the population of Manado. But there still can be economic damage.

Already there have been investigation on what the most vulnerable areas are along the rivers in the Manado city area. In the following picture, areas are outlined and numbered that are considered to have a serious risk of being flood the next time there is a big rain with large discharge.

Figure 1: Area overview with indication of the problem areas

In this case the problem areas are divided in three different areas. The first area denoted with one is in the suburb called Tumumpa. This area is in the most northern part of Manado city and lies where the Bailang river flows. The area is mainly used for industries and some housing. Also a fish port is located at the seaside of the area. Especially the area directly positioned next to the banks of the river are most vulnerable to danger of flooding. This covers a length that is from the mouth of the river up to approximately 1 km land inwards and spreads out around 50-75 m out to the sides of the river.

The Second area is considerably larger than area one and three. The areas are found around the Tondano and Tikala river. The suburbs considered here are Tikala Baru, Karame , Ketang Baru and Paal Dua. These areas have the largest risk of flooding with the next big rain. The area most consist of housing and some are only low lying open fields. So flooding give a lot of nuisance and hinder for the people living there and travelling in and through the area.

The true area in m^2 (square meters), considered in the graphic representation, is for Tikala Baru around 15.000 m^2. The Karame in that case has a danger area of 10.000 m^2, but nevertheless it still is as large as 2 soccer field's. The Ketang Baru is the largest area and is approximately 125.000 m^2.By that it also is the most interesting area for research. The last one is the Paal Dua area that is only 5000 m^2.

The last area is furthest south and is located around the sea mouth of the river Sario. The area is considered the least vulnerable, but vulnerable nevertheless. The terrain consists of mostly fields and some scarcely placed houses. In m^2 it is a not so interesting area, because it's only like 2500 – 5000 m^2.

In total the area is about 175.000-200.000 m^2. To put this in perspective, it is equal to 8-10 full size soccer fields. This, being in the middle of a city, can cause extensive damage and hindrance for the people living there. Within this figure the considered areas are assumed to be really drowned and that life threatening situation can occur. The real area of hindrance could be ten times that large, because only a small layer of water can already make the road unfit for driving a car .

1.1 General description of water system

To get started with the analysis a quick overview of the system which is dealt with in this part of the project. In this case a systematic distinction is made for the waterflow system in and around the City of Manado. The first step is to divide the area/system into 3 different parts, which together produce the flooding problem, but have incoherent causes that contribute to the severity of flooding.

A distinction is made between three parts , knowing:

- The coastal area;
- The delta of rivers;
- The catchment area.

Furthermore several cause are mentioned per group. In the following diagram this system with contributors is set put against each other.

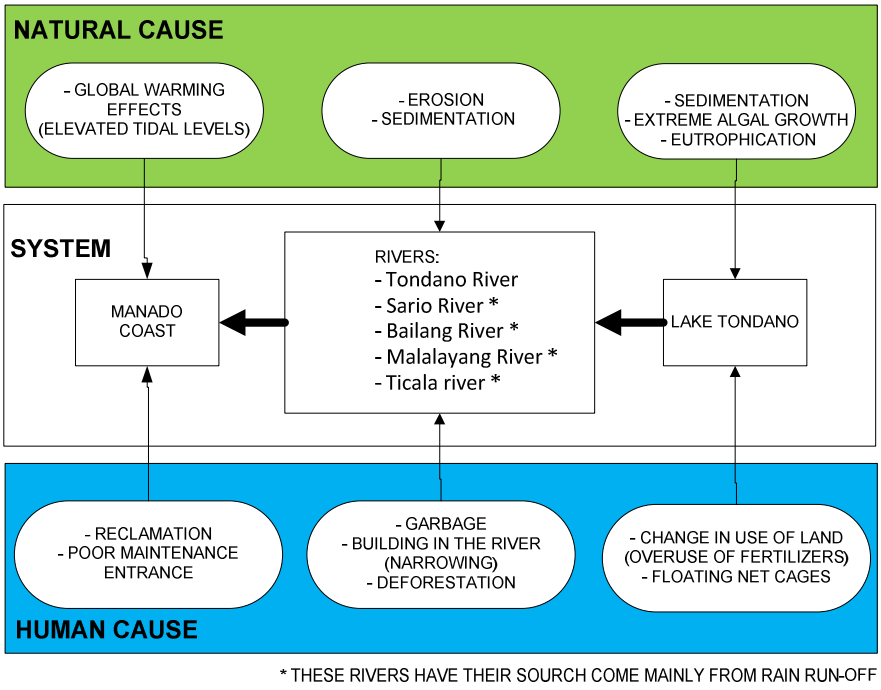


Figure 2: Water System Diagram

The contributions are divided in another two groups, the one which have a natural cause and the one having a human cause. Some of the natural causes are directly related to human intervention and vica versa. To give one example the overuse of fertilizers in agriculture (phosphorus) is responsible for the extreme algal growth in the river and by that the effect of eutrophication is fuelled. Which in itself cause sedimentation in the river/lake.

These scheme will gradually be explained in the text following. Some of the connection will also be explained as told earlier some problems have a (non-)human cause but act as the first of a series of effects the can be best described with the 'domino-effect'.

In addition to this a quick list is given of some of the facts and stories surrounding the flooding accidents of the last decade, starting from 2000:

Dated December 1, 2000 there was a flood which was preceded by heavy rains continuously for three days and the difficulty of water into the sea because the sea in a state of tide. High inundation reached 2.5 m. Comprehensive flood in December 2000 occurred all over the province of North Sulawesi.

- Dated January 6, 2002 floods inundated residential areas in the watershed Tondano-Tikala;
- Dated January 10, 2003 due to river overflow Mahawu;
- Dated March 11, 2004 and Tikala-Tondano River overflowed causing floods in several districts throughout the watershed Tondano-Tikala;
- Dated April 16, 2004 River overflowed and flooded the village Sario Tanjung Batu;
- Dated January 4, 2005 due to river overflow Mahawu;
- Dated February 13, 2006 S. Tondano, S. Tikala, S. Sario and S. Mahawu overflow flooded several sub districts in the city of Manado.

2 What is the problem

The frequency of flooding in Manado is about once a year. These usually are minor and don't cause much damage. The frequency of a large flooding is on average every 5 years. In the last 10 years there have been big flooding in 1996 and 2000 and 2005, in each occasions there were fatal casualties to be mourned.

The main question is what is/are the problem(s) in Manado city that cause flooding of the city area. The problems can be divided into three main groups. These groups consist of problems concerning a high (extreme) discharge level during rainfall in the city and mountains around Manado (Rain run-off), high (extreme) tidal levels and a part that involves hydraulic resistance. With hydraulic resistance one can think of rough river bottoms, sharp river bends, unnecessary obstructing structures etc. that have a large influence on the fluid flow through the rivers. The first one to be addressed is the high discharge part.

2.1 High discharge

The most evident cause of high discharge are the heavy rainfalls that happen mostly in the rainy season. This is from the months September/October until January/February. During these showers the intensity can be up to several 100 mm's /hour for a short period. In this document, of Asian Pacific FRIEND. a country report is made for several countries in the Asian pacific region. In these reports an analysis is made with the use of rainfall data collected by the Badan Meteorologi dan Geofisika (BMG) (>1990) and the Research Institute for Water Resource (RIWR) (<1990). Before setting up an IDF (Intensity Duration Frequency) curve, first all the rainfall data must be collected and processed to provide average rainfall height and intensity. The IDF relationships are used in the rational method to determine the average rainfall intensity for a selected time of concentration. The IDF analysis involves the following steps:

- Starting with essentially continuous rainfall data, establish a criterion for identifying independent events;
- Identify a series of rainfall durations to be analyzed, for urban design durations of less than 120 minutes and sometimes as usual as 10 minutes are desirable;
- For each time (e.g. 15, 30, 60 minutes) scan the events, which have equal or greater durations and identify the largest rainfall for each event;
- Process those data using statistical analysis techniques and establish the best fitting distribution (Pearson III, log Pearson, Gumble, etc).

In the article three independent formulas for calculating rainfall intensities are used knowing Talbot's, Sherman's and Dr. Ichikuro's formula. Out of these three, a comparison studie shows that the Talbot formula has the lowest mean derivation in the three cases, in which the formula was tested for a return period of T = 2 years.

Talbot's Formula

$$I_T = \frac{a}{t+b}$$

I_T is the rainfall intensity for T year return period in t minute rainfall duration,

dimensioning mm/hour. Constant a and b can be described as:

$$a = \frac{[\sum(I \cdot t)][\sum(I^2)] - [\sum(I^2 \cdot t)][\sum(I)]}{N[\sum(I^2)] - [\sum(I)][\sum(I)]} \qquad b = \frac{[\sum(I)][\sum(I \cdot t)] - N[\sum(I^2 \cdot t)]}{N[\sum(I^2)] - [\sum(I)][\sum(I)]}$$

N is number of data (year) and I is rainfall (mm).

With the Talbot formula a graph is made, in this graph one can see intensity plotted against storm durations with 4 different return periods.

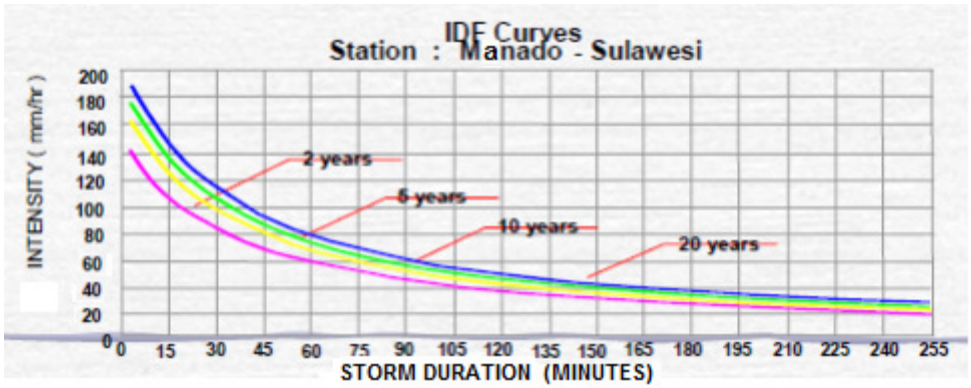


Figure 3: IDF Curves

One can see that for a return period of 5 years (taken the fact that the time between big floods in Manado city area is between 5-10 years) in 1 hour 70-75 mm of rain can fall down. These amounts can cause serious problems when the drainage and rivers are not capable of handling such rain run-off. In the case of a once in twenty years event, the rain intensity during a one hour storm can be as high as 80 mm/hour.

This all plays an important role in the discharge levels in the rivers around Manado. In the following picture a representation is given of the runoff areas that are found in Minahasa area. Every marked area stands for one separate run-off area. These areas are derived from ground level analysis, gathered from satellite observations.

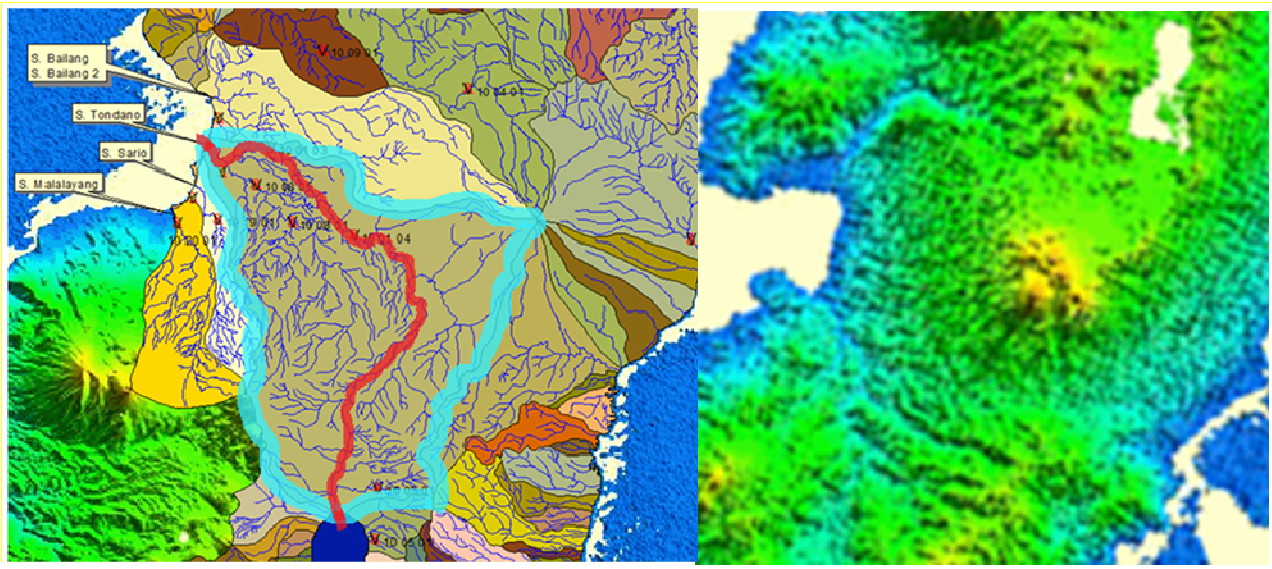


Figure 4: chart of the Tondano Run-off Area; Altimeter satellite image

Compared to other areas the 'Tondano area' is the biggest of run-off areas. One could expect the most flood problems in this area. In the picture the main river is marked with a small dark marking and the total area is marked with a light broad band. Next to that a satellite ground level map is given.

All these facts contribute to high discharge levels in the rivers and when these rivers can't handle this, they will cause flooding in the least protected and lowest parts of Manado City. The following concern is that of changes in weather patterns, because of global warming.

Because of global warming the weather all over the world gets more unpredictable and shows an increase in unpredictability. The only discovered pattern in the worldwide data is that wet areas are getting wetter en dry areas get dryer. Also intensities of the rainfall are become heavier making the risk of a flash flood, the most dangerous type, even greater. For now this is an inescapable fact that is felt all over the world(!).

2.2 High tides

The next object of interest to the flooding problem is the tidal movement in front of the coast of Manado. The first thing to say about the tides as an individual contributor to flooding is that it actually doesn't hardly cause any flooding. The river outlets are not obstructed by any means so the tide can come in without being reduced by any means. In this way the tide can push up the river levels. This especially is noticeable in the coastal area, because the tidal wave is much shorter than the watershed. In the picture an impression is given of this fact.

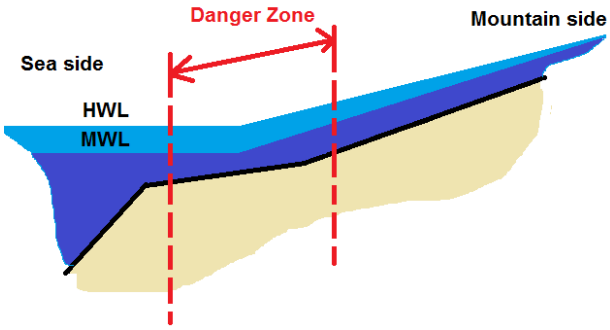


Figure 5: Schematic representation of Tidal influence on river water levels

In the danger zone the river can be pushed up. How much depends on the intensity of rainfall in the watershed area. This gives a little clue in which way a high tidal level can have 'flooding' consequences. In the highest recorded case, the tidal level was 2.5 meters above the zero level (defined here as the lowest astronomical tide). From the data collected it can be shown that on top of this also waves of 3.5 m occur near the coast that can give an additional storm surge level, that increase the effective tidal level in the range of >1 meter, thus enlarging the dangers of flooding.

This problem is already known at the public works office. The river outlet can't be just closed off to keep the tidal wave out. The problem they face then, is not being able to keep their drainage system from discharging in the sea under natural declination . The inlets as shown in the photo represents there are no structures to regulate or obstruct the tidal wave from entering the river.

Figure 6: Photo of the Sungai Sario outlet

2.3 Hydraulic obstacles

Hydraulic obstacles are hindrances in a river, which cause resistance of the river flow and discharge. A few examples of hydraulic obstacles are dams, bridge piers, abutments, narrowing of the river or just a very rough bottom. As stated before, this obstacles cause flow resistance and predominantly leads to a raise in water level. This water level , again, can lead to flooding. Because the width of the river decreases, when narrowing the river for instance, the height of the water level has to increase to gain equilibrium again. This phenomena are also present in the rivers in Manado.

The rivers in Manado and the surrounding countryside do have a lot hydraulic obstacles. In these rivers hydraulic obstacles like bridge piers, dams, garbage, plants, fish cages, a lot of sediment and abutments are present. To deal with the flooding problem, the hydraulic obstacles have to be analysed as well as an investigation into the contribution of these obstacles.

Figure 7: River Sario, picture taken from a bridge crossing

Narrowing of the river

In the city of Manado a lot of rivers are narrowed. Especially near the river mouth, where a lot of people live, the rivers are narrowed. The narrowing of river actually starts at the location where the river enters the city borders. People like to live near rivers and the sea, so, like in Manado, they build their houses at the river borders. When there isn't enough space left, they simply narrow the river to build their house alongside it.

The fact that people are living in the floodplain, involves an increased probability of flooding consequences. Like it has been stated before, narrowing of the river decreases the width and therefore the water level raises because the discharge does not change. Especially during high discharge this can cause a lot of troubles and eventually flooding. So it actually means that the rivers aren't deep enough to compensate for the narrowing of the rivers.

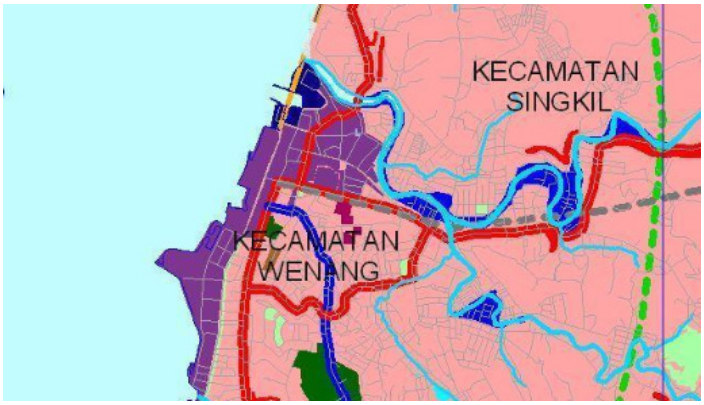


Figure 8: Problem areas

Noticeable is the fact that the probability of flooding is the largest near river bends. This could be seen from figure 12, the dark blue colour presents the largest flooding probability. The reason for this could be the garbage clogging up at the outer bends of the river. Another explanation could be the fact that people narrowed and fixed the river, so this cannot 'meander' anymore and will therefore overflow.

Bridge piers

Besides narrowing the rivers, people also build a lot of bridges in Manado City. Which is logical as people went living in the floodplain; they need bridges to cross the river. This bridges, however, cause hydraulic resistance of the river flow. One might think that one bridge do not influence the flow, because the water can flow around the bridge piers easily. Nevertheless, bridges have several piers and there's also not one single bridge, but there are plenty of bridges in the area of Manado City. So all these little influences on hydraulic resistance, altogether will cause a large amount of resistance. In figure 13 it is visible that the bridge piers also cause a clogging up of garbage.

Dams

Like bridge piers, dams also cause hydraulic resistance. Like for instance in the river Sario, there's a little dam with a small overflow gap. During low discharge, this dam almost entirely blocks the river flow, except for the little overflow gap. This doesn't lead to any problems. The problems start to occur during high discharge when the dam is really have become a hydraulic obstacle. So, like narrowing the river and building bridge piers into the river, dams also contribute to the overall hydraulic resistance.

Garbage

Another problem is the surplus of garbage in the rivers. Garbage is not fixed hydraulic obstacle, like the ones described previously, but are little pieces that clog up the river, especially near hydraulic obstacles. Not only the rivers are getting clogged up by the garbage, the garbage only contributes about 5% of the total hydraulic resistance, instead it does clog up the sewer channels. This clogging up of the sewerage causes flooding too. In **Error! Reference source not found.**, the idea of garbage clogging up near hydraulic obstacles is visible.

Figure 9: Garbage got caught behind bridge pillars

The problem of the surplus of garbage, thrown into the river by local people, does not contribute a lot to the flooding problem. It actually does influence the neighbouring under water nature reserves. The river transports the garbage to the sea, where it's being transported to the 'Bunaken'. This causes coral and fish dying because of the pollution of the garbage. Not only the 'Bunaken' gets effected, but also the water quality of the river itself will get worse because of all the garbage thrown in the river.

So the garbage problem actually effects two major problems of Manado City. When nothing will be done about this, it will result in losses of nature ecosystems and the flooding will continue. One of the solutions for this problem could be, use disadvantages to ones advantage. So in that way one uses the garbage beneficial.

The problem also lies within the mind-set of the local people. People are used to throw their garbage into the rivers, so it's not their problem anymore. In the past, the city authority tried to construct a construction that could collect garbage from the river. The only problem was that the garbage piled up along the river, next to the houses of the villagers. So when the smell got unbearable, the locals destroyed the structure and thrown the garbage in the river again. Nowadays there are some garbage bins in the city and they empty these bins regularly. Again, the mind-set of the people isn't changed and they still throw their garbage in the river, simply because people aren't aware of the consequences. This might be one of the biggest issues regarding the garbage problems.

Plants

Unlike the garbage problem downstream near the river mouth, plants are causing trouble upstream. The problem actually starts at lake Tondano, which will be discussed in the part on catchments problems. The plants flow into the river and causing some hydraulic resistance. At some locations local people collect these plants and get them out the river, but they do not get those plants out very regularly. So after some time, this will lead to quite a resistance. The good thing about this is that they actually do catch the plants.

Fish cages

Just like plants, fish cages also cause hydraulic resistance upstream of Manado City. However, the problem do lies closer to the city borders. There are quite a lot fish cages in the village Ternate which blocks the river flow, especially during the peak flow since the garbage was accumulated at that village. So the combination of garbage, plants and fish cages together causes a lot of hydraulic resistance and do contribute to the overall flooding problem.

Sediment

A final impact to the hydraulic resistance is the sediment in the rivers. Because of the deforestation, heavy rainfalls cause landslides. Subsequently, a lot of sediment will flow towards the rivers and again during heavy rainfall this sediment will be transported by means of the rivers. This sediment flowing through the rivers cause hydraulic resistance. During low discharge the sediments will settle and will cause siltation of the river and therefore also cause resistance.

2.4 Catchment areas

One of the sources of flooding Manado City is the problem at the catchment area, namely near lake Tondano. The fact that too much water flows through the rivers during a peak period, actually is because lake Tondano cannot retain too much water. When there would be enough space in lake Tondano to retain all the water during heavy rainfall, water could be discharged gradually. One should, however, construct a discharge regulator to realise that. Nevertheless, the fact is that lake Tondano isn't large enough to store all that water.

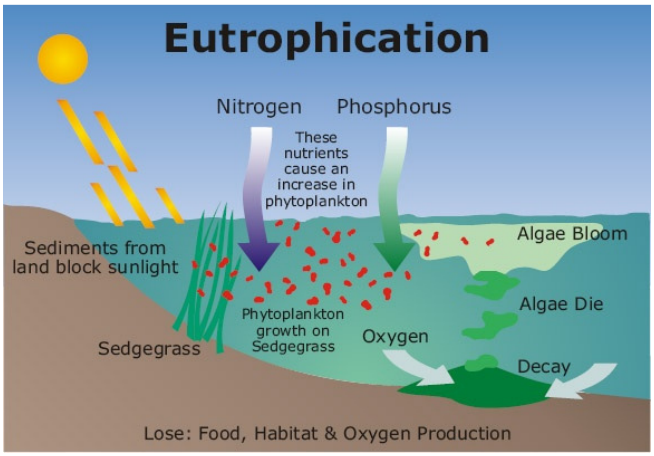


Figure 10: Representation of Eutrophication

The fact that lake Tondano is not large enough, is because it actually is too shallow. One of the reasons for that is that lake Tondano is full of water plants (eichornia crassipes) called ''Eceng Gondok'' in Indonesia. It is because the fertilizer for the plants (agricultural products) flushed into the lake from the land surrounding the lake. It's like an early stage of eutrophication and this will lead to more flooding. It is a sign of poor urban (spatial) planning and surrounding regional planning for sustainability. If not well taken care of, everything will get worse like for instance groundwater, and increasing peak flow and decreasing low flow.

Another reason for shallow lake is sedimentation, as discussed before for the hydraulic resistance part. Deforestation and landslides will cause sediments to flow into the lake and worsen the problems.

The plants and sediment eventually flow into the river, as stated before. To prevent this, something has to be done. But no real simple solution could be found, otherwise authorities had done something about it. A solution could be found in dredging the lake, however this is too expensive. So to solve the flooding problems in Manado, one should also search for an solution of the shallow lake Tondano.

3 What are some of the measures

The flooding in Manado are happening for some decades already. In this time several attempts have been done to control the flooding and prevent it from happening. This has been only successful on a few occasions. Out of interviews with people that are closely involved with the flooding problem there are plans for large scale improvements for the most problematic rivers in the area, knowing the Tondano and the Tikala river.

In Sulawesi the river area responsibility is divided over several different organs. The embankments and flooding protection is the responsibility of the National Government and all the things around it are the responsibility of the Local Government. This makes it harder to do something about the flooding problems, because the problem is both national as local. For an optimal solution both parties have to work very closely.

Some of the past, present and future developments in improving the river will be further discussed down below.

3.1 In the past and in the current situation

Flooding in Manado is not new to her inhabitants, the flooding has always been a problem for Manado. Especially when they began to grow and made plans for expanding the city even more. With the expanding the inhabitants began to build more and more towards and in the river, reducing its capacity more and more until they started to get trouble with flooding.

The first works to be done on the river where the building of revetments and walls to keep water from entering their houses and the street. From an engineering point this will only shifts the problem to an upstream neighbour because people create bottlenecks and not give room for the river to freely flow downstream. Making the problem only bigger and bigger without finding a real solution that makes it also safer.

The existing method of dealing with the flooding risk is to further heighten the revetments. A good example is shown in the following figure. It was told that this renewed heightening of the revetments followed the recent flooding events that occurred in the area.

Figure 11: Photo of the measurements taken in preventing areas from flooding

In the figure a clear distinction can be made between the existing revetment and the extension of it. The quality of the masonry look to be consistent and have sufficient strength to cope with water. This solution does not really contribute to safety in terms of reducing risk of flooding, this kind of structure gives a false feeling of safety.

3.2 Future plans

Having talked about the past and current situation of flood defences in Manado. One must know that the city of Manado also has plans for future development of protection along the river. The first of two examples given is already constructed. This was done in four separate stages, the first one starting in 2007 and the last one starting in the year 2010.

Figure 12: Revetment improvement in Tikale watershed

In the figure above a part of the renovation work in the Sungai Tikala is on its way towards completion. This structure is build to strengthen the outer bend in some part of the river. Together with this function it also helps to prevent flooding of the hind land. The total cost of these projects is to be about 7.7 milliard rupiah (with today's exchange rate that is almost € 700.000,-) out of a total budget of 50 milliard rupiah to overcome flooding problems in the Tikala Area.

The next example is one still in the preparation phase. It is called 'urban flood control' and its main goal is to protect and improve the Tondao river's embankments. For this project the city/government wants to improve not only the weak parts in the river, but a new revetment along the complete trajectory of Tondano river.

The plan is to make a revetment along 14.000m of the Sungai Tondano. This revetment will act as a defence against high river levels and must also improve the flow through of river discharge. In the context of this they also try to encourage people to stop throwing their garbage in the rivers. In the following figures the area is outlined in which the project will be implemented.

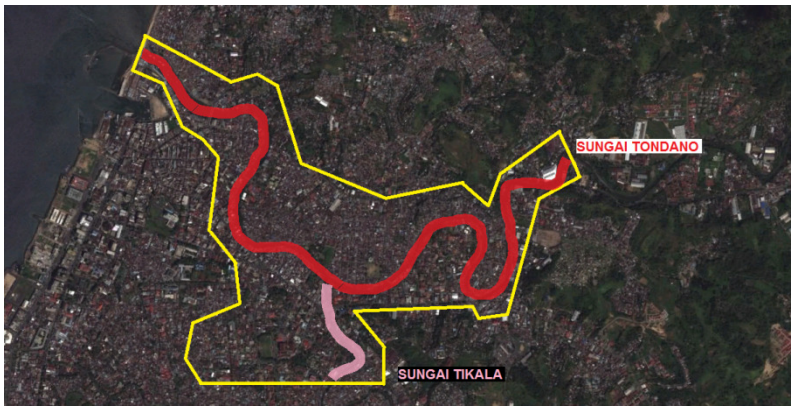


Figure 13: Project area Tondano river improvements 'urban flood control'

Next to this an artist impression is given of one of the many sites along the Tondano river. To leave a remark most probable the design will look different after the design phase is finished because the river knows a lot of variation in width and depth.

Figure 1: Artist Impression of Urban Flood Control plan

The project will hold the following subjects:

- Construction of flood embankments;
- Strengthening the cliff, river normalization (canalization);
- Placing a dam, constructing a reservoir and a multipurpose flood control in order to hold the flood flow and reduce peak flood flows;
- Socialize / introduce and develop the wells.

These subjects are part of the urban flood control programme that will start in the year 2012 when everything is discussed and the work is approved by the government.

3.3 Conclusion

The conclusion must act as the good reference for the following step, making the Flood Prevention Plan. In this plan one can read motivations and possible solutions surrounding the Flooding problem in Manado City. The most important conclusion that can be drawn from this River Flooding Analysis are summed together in the following points of attention, knowing:

- The problem with Flooding is concentrated in the City of Manado. This is largely due to the low lying position of the city;
- Most rivers are having problems dealing with large discharge volumes. This has several reasons, the three most important are:
    - Garbage ;
    - Sedimentation (during small discharge);
    - Building in the river (Making and placing obstacles in the water that reduce flow through.
- Solutions are needed on a short notice, within the analysis it was explained that the return period for an Flooding event is about 5 years. Any solutions thus will be tried to be of a short-term nature;
- There are already some future plans, as supplement in the Flooding prevention plan it is evaluated in short to see wear maybe any weak or strong points lie.

These conclusions will form the building blocks of the Flood Prevention Plan.

Appendix E
Geotechnical Analysis

Contents

List of figures

1 Geotechnical Analysis

1.1 Introduction

Close to the so-called “ring of fire” Indonesia knows many active volcanoes. These volcanoes also created the Indonesian Islands. Centuries ago, many evaporations created small islands. Due to continuous lava flows the islands grew. In the region of Manado this geologic history can still be seen. Several volcanoes are highly active, many stone quarries can be found in the surroundings of the city. Not only igneous rock is found in these quarries. Gold is also present in these rocks, it is one of the high value materials found in the region. Besides igneous materials also sedimentary rocks are present. This limestone can be found along the coasts. Created by corals and shells which still live at these places. Building new limestone everyday (however on a very slow rate). In specific the Bunaken, a special and large coral reef near the city of Manado.

More or less these characteristics can be found in the anatomy of the city of Manado and the Minahasa region. Inland there are flat lands at high altitudes, volcanic mountains and crater lakes. Going through the highlands you need to cross these mountains. Following the long slopes downward one eventually arrives at the coastline. Along the coast of North Sulawesi there are 4 types of beach profiles which can be found. The Development Centre of Marine Geology Bandung classified these types based on present geomorphology.

Coastal Flood Areas

Within small branches land inwards, sometimes established by rivers or tidal seawater, swamp areas can be found. Present soil types are generally alluvial and loosely packed. Due to its origin the beaches are highly unstable. Erosion is a common trait to these areas.

Figure 1: An Coastal Flood Area on the island of Bunaken

Coastal Area with Steep Cliffs

Cliffs at the coast are characterized by hard rock (igneous rock, lava, breccias, conglomerates and sandstone). Nearly no rivers are found in this area. The coast is generally rugged and very steep (slope angles of 45° up to 90°). Although the process of erosion is still ongoing, the process is generally stable. Rocks and sand pockets are commonly found, as the main constituent material is volcanic rock.

Figure 2: Baron Beach, near Yogyakarta [source: http://wisatayo.com/]

Coastal Area with slops

A controlling factor in this geological conditions is the presents of low to moderate resistant rocks (alluvial and sediment deposits, like sand and krikil, in the form of lakes and rivers). Slope angles which can be found in this region are lower than 30°.

Figure 3: Example of a beach with slopes, location Sepanjang, West Java [source: http://www.pesonagunungkidul.com/]

Coastal plain

In these area's the beach is highly unstable. Erosion processes have become dominant or a common phenomenon. Materials consist of alluvial rock, lake sediments and river sediments. Dry land is used, after settlement, for agriculture and plantations.

Figure 4: Part of the Coast near Batusaiki, Manado, North Sulawesi, which is heavily eroded

Profiles of the coast are actually often following the theory of equilibrium. Influenced by the deviation of the seabed, presence of obstacles and the properties of material. Like rocky coastlines are less influenced by the erosion process compared to sandy coastlines. Reaching this equilibrium can take a severe time, or this equilibrium profile is even not desired. This information is essential in relation to the analysis of the most common coastal processes at a specific location. Because the geotechnical properties have less to do with this process. The future analysis is done in the coastal section of this report.

2 Erosion

One of the researched subjects are the erosion challenges within the borders of Manado City. At the southern site of Manado there is a lot of erosion. Manado city already undertook some measurements to stop the erosion on this particular site. By this reason we will not focus on the same area. Additional analysis showed us more weak spots along the coastline. Namely in the northern part of the city. Currents which follow the coast from South to North cause severe damage on weaker spots. This is already stated in the coastal analysis. Natural protection, by mangroves, is sometimes enough. The plants flourish in shallow tidal waters. Where their roots grow into the white sands. Their roots improve the stability of the sands and hinder erosion to take place. Mangroves demand specific properties before they start to grow. Different measurements have to be taken at places without Mangroves, or the environment has to be made "Mangrove friendly".

2.1 Batusaiki

For example near Batusaiki, this is a neighbourhood near Molas. During several years erosion has vanished trees, plants, houses, drinking wells and abandoned the people living near the past shoreline. This spot will be taken as an example for strengthening the erosion weak spots along the coast. In Figure 5 one can fine the location of Batusaiki. This neighbourhood is located in the northern part of Manado.

Figure 5: Geographic map of Manado

By looking from a geotechnical point of view the site shows some similar properties compared to those of Manado city in general. Batusaiki is situated at the border of the city. In this region construction are very simple. Before one builds something, in most cases, there will be no intensive geotechnical investigation. There is no need to do this. Local building experience is enough for building a safe construction. By this construction philosophy there is not much known about the subsoil in Batusaiki. Investigations are done when they are truly needed, and (not less important) are funded by the client. This analysis is based on visual inspection and different investigation in and around the city of Manado.

Figure 6: Cross section of the upper layer.

Figure 7: Example of the present sand

In the area grow many plants, palms and high grass. Observing this indicates the upper meter of soil is very fertile. By this observation one can say the upper meter of soil contains a lot of clay with organic material. At the coastline, where erosion already took place, one can see the start of the change in layers. The underlying layer starts with sand. Properties of this blackish sand are uniformly graded with a d_{50}= 0.5 mm, igneous origin making the grains very sharp giving the sand an high angel of internal friction. Looking at Figure 5 one can notice Batusaiki is located at the edge small mountain named Tumpa. Not surprisingly this mountain is created by volcanic activity and so increasing with depth more en more young volcanic rocks can be found. Eventually rock layers will appear. Rock types found are mainly of a basaltic composition.

2.2 Additional site

The site at Batusaiki is taken as an example for the erosion case. Analysing this particular site is done accurately, but with a focus on the case study. Besides Batusaiki, one also want to know the geotechnical situation near the Boulevard. Reasons can be found in the brought view which contributes to a complete understanding of the whole coast. In the future there can also be more developments in this area. Extended knowledge about this area comes in handy at that moment. By the knowledge of this area assumptions can be made for the rest of the coast, because this area of the coastline is representative for the coastline within the borders of Manado City.

Figure 5 also shows the location of the Boulevard. It can be found in the centre of the city. In the past, about 2 generations ago, the boulevard still was the beach. To get a better accessibility the city of Manado decided to construct a large road along the coast. At that moment the construction site was on the shoreline and they had to construct small land reclamation areas to build the road on top. Nowadays this road is called the Boulevard. These condition give a combination in the geological profile. From the surface downward one finds first a big layer of sand disturbed or even replaced by men. Below this the former soil surface is found. Build by nature over several millions of years.

Figure 8: Example among the Boulevard where the road is still next to the coast

Manado city is build among a few rivers which end in the sea. These rivers have collect over time many sediments and other geological materials. Starting high up in the mountains they stream through the young mountainous areas, passing fertile tuff areas and eventually pass Manado city. All these areas have their influence on the geologic material coming to the city area. By these influences the deposits found in the Boulevard area are mainly alluvial materials. Many sands, mainly eroded from basaltic rocks, is found in the subsoil. Also some sandy clay layers can be found originated from the Tondano Tuff.

Through years of development the city of Manado expanded its land further into the sea. Newly reclaimed areas were constructed for shopping malls and Convenience centres. Looking at the profile of the coast nowadays, some conclusions can be made. Along the coast there are only several spots where land reclamation took place. This is because of the elevation profile along the coast. Some parts are more shallow and are thereby in flavour to be picked as reclamation area. After the shallow part the inclination of the seafloor is very steep. Analysing the seafloor one can say that there is a layer of sand on the top with a thickness of a few meters. Underneath this layer one finds a layer of limestone, made by the organic activity like corals and shells which flourish in this area. Going somewhat deeper the igneous rock is found again.

3 Floods

Several rivers pas through the suburbs of Manado city. Important to know is the function of these rivers. What do they mean for the citizens? And the rivers function well? In the previous part these questions which arise at first sight and during the investigation are answered. Weak spots can still be found along the river. Due to heavy rainfall upstream, the rivers will flood at these spots. Leading to damage on the surrounding, but also an increased risk to casualties along these rivers. The study involves a relative shallow, though overall investigation. There will be an advice towards the municipality of Manado. No technical design is made. Because of this goal, an overall knowledge of the geotechnical environment is enough. From the introduction one can conclude the most important factors. Whereby no further analysis is needed.

Appendix F

Construction Management Analysis

Contents

List of figures

The Ten Commandments for Developing Areas

I. They should blame only themselves for the failures in development. Blaming imperialism, colonialism, and neo-imperialism is a convenient excuse to avoid self-examination.

II. They should acknowledge that corruption is the single most important cause of failures in development. Developed countries are not free from corruption, but with their affluences they can afford to indulge in saving and loan scandals.

III. They should not subsidize any product, nor punish the farmer in order to favour the city dweller. High prices are the only effective signal to increase production. If there are food riots, they should resign from office.

IV. They should abandon state control for free markets. They should have faith in their own population. An alive and productive population naturally causes development.

V. They should borrow no more. They should get foreign investment that pays for itself. They should build only the infrastructure that is needed and create no white elephants or railways that end in the deserts. They should accept no aid that is intended only to subsidize ailing industries in developed countries.

VI. They should not re-invent the wheel. Millions of people have gone through the path of development. Take the well-travelled roads. Be not prisoners of dead ideologies.

VII. They should scrub the ideas of Karl Marx out of their mind and replace them with ideas of Adam Smith. The Germans have made their choice. They should follow suit.

VIII. They should be humble when developing and not lecture the developed world on their sins. They listened politely in the 1960's and 1970's. They no longer will in the 2000's.

IX. They should abandon all Manado-Minahasa-Sulawesi Utara forums, which encourage hypocritical speeches and token gestures. They should remember that areas that have received the greatest amount of aid per capita have failed most spectacularly in development. They should throw out all theories of development.

X. They should not abandon hope. People are the same the world over. What Europe achieved yesterday, the developing world will achieve tomorrow. It can be done.

Kishore Mahbubani

1 The assignment

1.1 Case study

The municipality of Manado has a renewed vision for the future, Manado Model City for Ecotourism. In the last few years the increase of garbage in and around the city is expanding, which results in a damage of the greatest natural good the city have, The Bunaken Marine Park. Not only the total tourism branch will be effected by this new vision, also the construction industry have to transform into Eco-Friendly-Engineering to accomplish the common vision.

Besides this clear vision they also launched their mission for the next coming years, To Make Manado as a City of Happiness. The inhabitants of the city experience a decrease of happiness due to the decay of public areas. Inside the city there is huge traffic congestion and pedestrians face difficulties walking on the streets. Also the already mentioned accumulation of garbage creates an atmosphere, which is the opposite of what everyone likes, total happiness. These nuisances result in the new mission of the directors.

To accomplish these vision and mission the strategy is as followed:

1. Realize the quality of community life, in harmony and peace;
2. Creating a comfortable urban environment;
3. Build identity and image of the city as the World Ecotourism Model;
4. Increasing the role of Manado in the region's economic development;
5. Implementation of good governmental management.

Civil engineering projects have, next to the administrative subjects a major role to achieve the goals of Manado City. Therefore there is a need to give a proper advice about the methods that are used to complete the projects in time and budget with the support of the environment.

1.2 Objectives

The first stage of a **process** lies in the recognition of a problem or the development of an idea. This moment is point out as the start of the initiation phase. During this phase all kind of analysis will be made and possible solutions have the change to pass the legislators of the City Council. The analysis consist of different aspects that are needed to fulfill the demands and needs of the society. For instance the stakeholders and their interests, SWOT to identify opportunities and threats and the feasibility to investigate the benefits and costs. Once a detailed understanding of the current processes are obtained, various process modeling techniques are used to identify the essential aspects. From this stage the future process can be advised.

At the time the final design is approved by all the agencies the **project** is about to begin. Different companies challenge each other to win the tender by the lowest bid. A full detailed planning will be made and manpower can be hired to build. In this chapter different management techniques are described, that will be used to analyze the management approach in the construction industry in Manado. The analysis of the current techniques, will give an indication of the current state of the management approach. Based on this indication an evaluation can be conducted. Based on this evaluation, an advice can be given if the approach miss specific items.

At last but not at least the **Recommendations** for the municipality of Manado. After the investigation of the process and project management a clear and understandable advise is presented to achieve the vision and mission of the city.

1.3 Process vs. Project Management

Process management is in the construction industry the business that can be summarized as the philosophy of a goal seeker. During all phases of a project it has to deal with unknown or partly known goals and stakeholders. Decisions will be made on the basis of strategy, pros and cons are analysed and trade-offs will end up in a common goal that fits for almost everybody. The context of the process is interwoven and erratic, every stakeholder has his own interests and think strategically to ensure his personal goals will be reached.

On the other side is the Project management, an unique and clearly delineated management discipline with clear goals and requirements. The total control of budget, time schedules, labour, organisation, information flows and quality are the main tasks to make operational decisions. The actors and stakeholders are known in this “frozen” context.

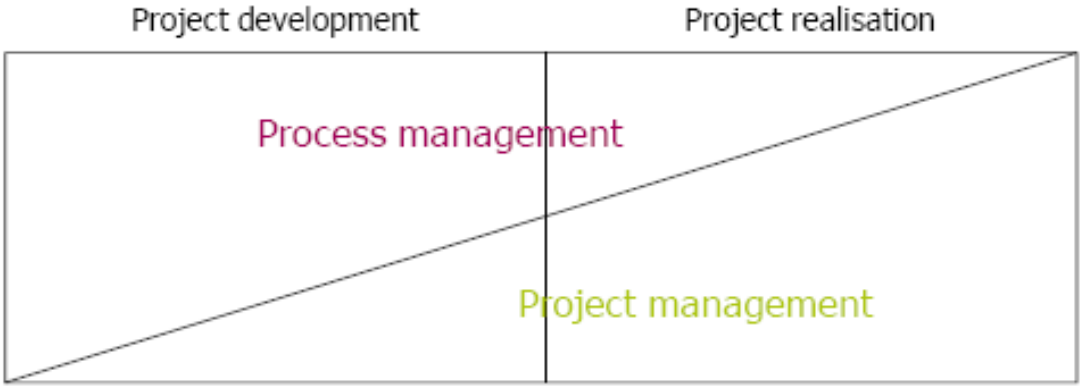


Figure 1: Relation process and project management

The figure above shows the relation between Process and Project Management. During the initiation and development phase there are a lot of uncertainties, like budget and active stakeholders. The process management creates clear goals for everybody so the project management can continue on these fixed achievements during the realisation. It is unfair to claim that the process management alone is responsible for the development, also the project management will be included in these phase to come up with a proper planning and budget. In the figure can also be seen that the influence of the project management increase during the different phases. While the uncertainty decreases, the scope of the project gives the project management a proper guideline to fulfil their task. This transition from process to project goes very slow and in small steps, therefore these two types of management depend on each other and have a strong relation, but are totally different.

2 Process Management

Why process management? Like everything in live, the construction industry is build up in phases. It starts with the recognition of a problem or an idea and end up in a completion of a structure. From this moment all kind of processes will start. These long procedures, because of all sort of laws and regulations and conflicts due to the fact that different parties have diverging interests, has to be handled with care to prevent delays and overrun of costs. To give well based recommendations to you as the municipality of Manado a proper analysis has to be made of the current situation. In the following paragraphs the phase description is elaborated with an eye to the common way this happens in Holland.

2.1 Business case

When everything is uncertain, it is an art to create order inside the chaos. During this phase it is important to initiate projects successfully, get sponsorship support, conduct a technical feasibility study, collaborate with teams and stakeholders, develop and share necessary project initiation documents, and so on.

Developing a comprehensive business case is the first necessary step within the project initiation phase. A business case is a formal document with respect to a financial feasibility paragraph, that outlines the business problem or opportunity to be addressed by the project and available alternative solutions for addressing/exploiting the problem/opportunity. The business case brings a foundation for project activities and formally documents the reasons behind the creation of the project as well as the key benefits to be obtained and the costs required. It also specifies a list of recommended solutions for approval.

A feasibility study is an initiation document that describes the technical, economic, legal, operational and scheduling background of the project and is aimed at proving the success of project completion on time, within budget and as per technical specifications. The document also investigates the impact of external factors (such as Market, Competition) to the project and summarizes a solution. The feasibility study specifies a preferred solution that is to be approved by the sponsor.

Once both the problem (or opportunity) in the business case and the solution in the feasibility study are investigated and identified, project activities can be initiated to address the problem and produce the solution. At this step, project plan is to be developed. This is the primary project initiation document that sufficiently specifies what tasks and activities the project actually starts and what the boundaries of project work are. The document also shows what objectives, scope and deliverables are to be achieved within the project. It gives a clear vision to the stakeholders.

A business case, which is very common in the Western world, is not implemented in here. A detailed master plan of the region and especially the city of Manado is missing. The visualised pictures of the vision and mission are the only documents that are worth to be mentioned. This results in a lack of awareness of project rationale, project scope definition and feasibility analysis, by local projects. Every project, related to the vision and mission of Manado City is on its own. For most cases when they are funded by the national government these analysis are needed, except the feasibility one.

Besides the missing master plan of Manado, there are hardly no private parties involved during the initiation phase of bottom down projects, but only public parties. This so-called pre-project planning is executed by governmental agencies. They investigate and formulate the project on what they think is best for the region. In case of large civil engineering projects, the approval will be voted in the City Hall. In there the government, in form of legislators decide which project will be funded. This method ensures a democratic decision-making, whether or not the people who are voting have the capacity and knowledge of civil engineering which is needed for such radical decisions.

According to different sources this method of decision-making assume the appearance of corruption, due to the fact that by voting the projects will be approved. This can lead to an interferences of interests by the people who have to decide what is best for the city, community or themselves. Besides these suspicions, the use of governmental agencies for the delivering of necessary documents and certificates, is recently assumed to be in favour of the administrative parties.

2.2 Management techniques

The initiation phase as described needs to be managed. The most common management techniques are describes as the Hierarchy and Network approach. The main difference between these two major management techniques is the method that says something about how to deal with stakeholders and their constantly changing interests. To get a clear view of what the differences are, first the two approaches will be explained in the following sections.

Hierarchy approach

The first approach that can be interpreted as the management style that focus on uniformity. The greater the uniformity of the organization, the greater will be the span of control of an intervening actor. While the actors in specific top positions decide what to do, all other actors handle to the interests of the organization they represent. By setting and determine goals in the beginning of the process and not changing them during the process, this management approach is attractive for small projects where the goals are clear and simple.

This means for instance that it is less attractive for innovative projects, where a lot of complexity dominates and future goals and determinations are difficult to predict. The approach characterized itself by unilateral dependencies, which are not the case by large and radical projects. Adjustments will be achieved during the process by the trial-and-error principle or in accordance with the procedures for decision making. Standardization could be applied as it could reduce complexity. These standardizations will be implemented by the principal, most times the top of the hierarchical

Network approach

The second management approach can be read as the style that is all about projects with an high complexity rate. It is a management style based on variety, where nothing is fixed in advance, so it is prepared to adjust goals when circumstances change and so insight can be improved. Instead of the hierarchal organization, this approach is more stakeholder related. This means that the stakeholders interests are centralized and will function as the leading system in the decision-making process. This network related process means that it is dynamic and closed to hierarchical signals.

This approach can therefore be distinguished as a process with mutual dependencies. By the use of knowledge of participants to create a better design, a lot of consensus need to be made. If both parties speak with each other about the solutions, they will make arrangements on the possible outcomes, which will end up in an agreement for the design. The research that is usually be made to design, will now be skipped and safe some time, this will also increase the quality because the future users are involved so they can enunciate their needs. After all there are no conflicts on the outcome of the design.

Hierarchy versus Network

To get a clear view of the differences of the two approaches, a table is set up with the different aspects of the styles. These aspects will be explained shortly in the specific column. These differences are illustrated in table 1 beneath.

	Hierarchy	Network
Position	Fixed positions of authority/citizen; Boss/employee	Unclear position of members and non-members
Participation	Limited entry for Authority/Boss	Unlimited access for everybody
Rules setting	Authorities decide what to do, citizens/employees act in accordance with decisions	Authority dependent on scope and organisation
Decision making	Aggregation rules specify how to decide	Some collective decision making by members
Scope	General rules specify scope and jurisdiction of authority	Interconnected activities by members
Budget	Set by rules and decisions	Set by network, member-exclusive
Information	Authorities and rules decide when and how to publish	Actors decide which information will be available

Figure 2: Distinction between Hierarchy and Network, Book Governance

Based on these two techniques the management of Manado City, in relation to civil engineering projects of the vision and mission is analyzed. According to the interviews, this phase is managed on a strict hierarchy way, as can be seen in the following elaboration.

Position

The position of the members are fixed. The directors form the top of the organization chart, followed by a layer of management, who in their position executive the next layer of employees. Everybody in the organization is aware of his position in the governmental agency. By titles and dresses you know who is your superior and who earns respect, a perfect example of hierarchical management.

Participation

This bureaucratic structure of management forms a limited entry for authority and in most cases also for the boss. It is for directors inappropriate to tell the workers what to do, they should first inform the management with executive powers, which will tell employees what to do. Even so will the top management decide which company and governmental agency will be involved during the initiation, all based on the hierarchical management style.

Rules setting

When it comes to the rules setting the authority, in this case the municipality of Manado decide what to do. They are the rulers of the city and have the power to change regional laws and procedures, in order to fix in the higher level laws. When something needs a new rule to achieve certain goals the local authority has the right to do it. Which can be encourage by the local people. This indicates a management style that can fit both the approaches. The foundation is based on hierarchy but the adaption to a new and changing environment can be seen as a network approach.

Decision making

In addition to the rules setting also the decisions are made by the people with executive powers. In this way every decision takes a long time before it has been made, it has to cross the total administrative machinery before someone take the responsibility and decide what to do. There is a delegation of power and tasks in the administrative office. The responsible people are aware of their tasks and when they need to make decisions, but when it comes to tough decisions they will, in most cases, pass it through.

Scope

The rules set by the authorities are used as baseline for the outcome of the scope. Every decision which will be made to complete the design needs an approval by the laws. A slightly deviation from the general rules are not accepted. The picture on the next page indicates the implementation of spatial planning. Even though this pictures dates from 2003 and is therefore not up to date, it gives a clear view on the hierarchical character. The spatial and development planning from the city needs to fit in the spatial and development planning of the province, which on their turn need to fit in the national spatial and development planning.

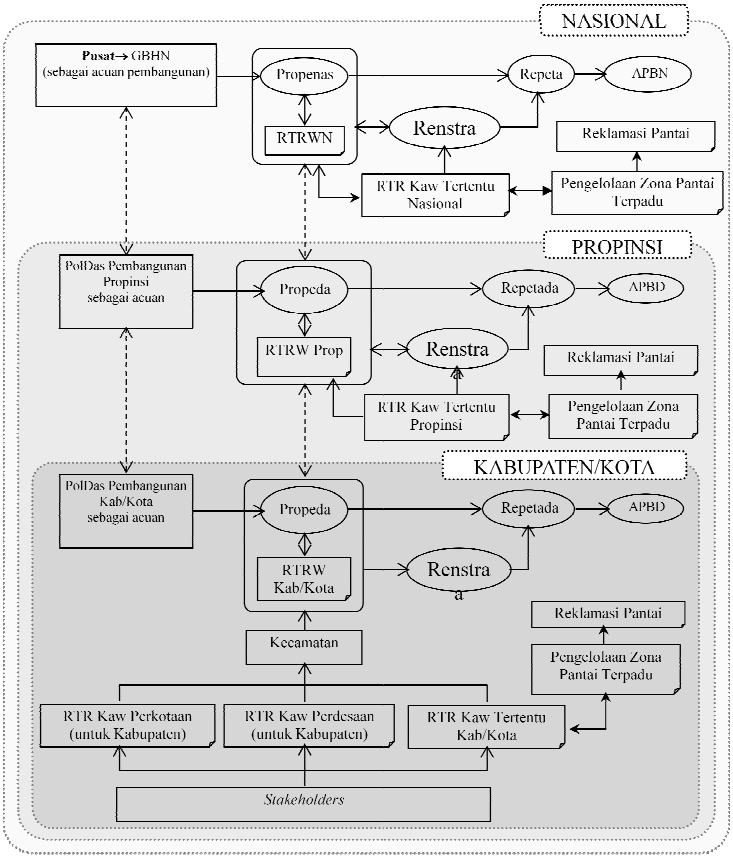


Figure 3: Process from the central to regional development

Budget

The money that is needed to construct a civil engineering product also need to pass through certain rules. Eventually it has to pass through the house of parliament, where by voting the decision will be made if a project can continue or not. The founding is limited and when the money is short, this bureaucratic method will continue to the national house of parliament before the money will be awarded to a specific project.

Information

The available information depends on the willingness of the authority. When they see the benefit to publish an article or document it will happen. In all other cases the crowd have to wait till that moment. For people who are trying to collect information about the plans of Manado will often face a difficulty to have it in their possession.

Eco Friendly Approach (Manado approach)

In the last couple of years the demand for eco-friendly engineering from the consumers rises every day. Parties who want to stay in front of the line should develop any form of sustainable, CO2 neutral or cradle to cradle production to keep the benefit of their position. This hype started in 1997 after the Kyoto Protocol was lunched. Governments pulled out their wallet and came up with extra funding to promote the reduce of CO2, carbon dioxide. Every factory, company, or government who is building in such a method, which will reduce the emission will be rewarded. These rewards can be a financial one or in most cases it gives them the right to wear a “green” label. An award which eventually put the company on a high standard with a substantial benefit.

To implement the Eco Tourism image to the city of Manado a new approach is necessary. A strict Hierarchy or Network approach is not the solution to the problem in a city like Manado. A combination of both approaches is the best way to manage the city in order to reach the main goal. Both the approaches have their advantages, based on the habits of the people diverted interests of the stakeholders.

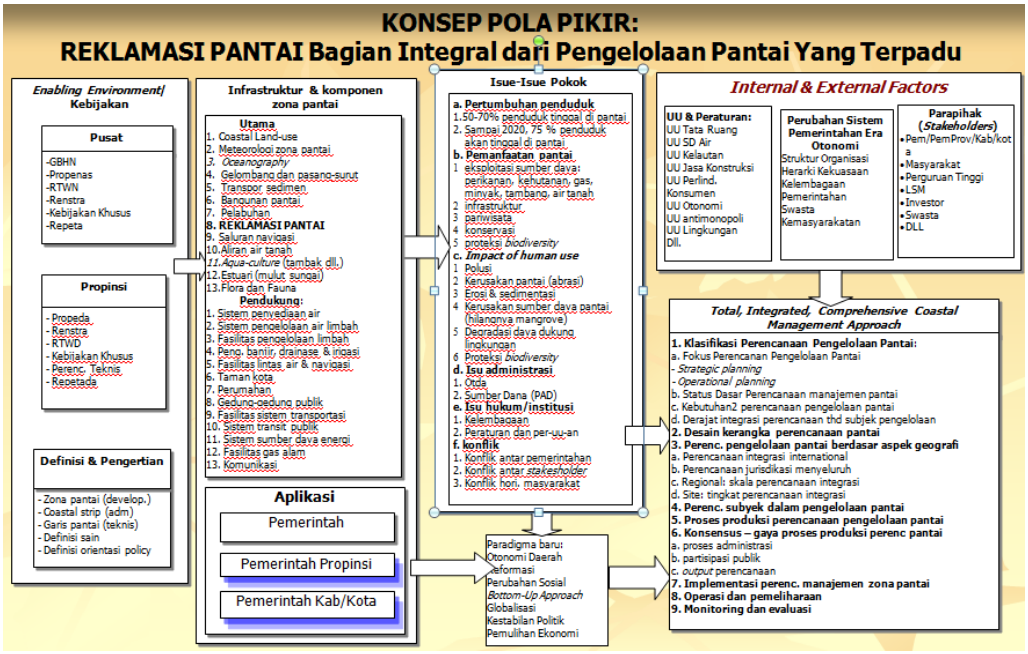


Figure 4: The concept of mindset.

Picture 4 shows a structure of the construction of a reclamation area, the third column gives the indication that they carrying out a stakeholder analysis as well as the impact of human use. The truth is slightly different. The city of Manado is aware of the need to map the stakeholders and environmental assessments, but the implementation of a high quality analysis is not yet come to an execution.

Green engineering communities are very useful to open up the eyes of the legislators. Nowadays the economical growth is in front of the preservation of the nature. A logical set of priority due to the fact that both aspects are not willing to improve each other. The legislators of the city only think about money and economical growth while their most beautiful property, the nature is washing away. Therefore a network approach is needed to fulfill the needs of all stakeholders that are involved in the plans of the city. They can provide the municipality with substantial solutions and ideas to develop the city, but only when the participation and information is unlimited.

On the other side is the mindset of the people not capable of a transformation to a 100% network oriented approach. They are attached to the hierarchical structure in almost all activities of life. Specific tasks are the common method in Manado to get everything done. This have a lot to do with the colonial period when everything was decided for them and they had no idea how to take responsibilities. The position of the directors must therefore be unharmed to make sure the employees and citizens act in a way that is needed for the development. This also include the rules setting, where a lot of ethnics represent the citizens of Manado.

2.3 SWOT

The SWOT analysis provides a summary and helps with identifying key factors relevant to the project and it's normally used in the preliminary stages of strategic decision-making. The goal of this SWOT analyze is to identify favorable and unfavorable factors affecting the outcome of the vision and mission. This analysis can be used as an advice to the strategy that ensures the best fit between external and internal factors and helps to decide what the most appropriate strategies are for the current achievements based on the internal and external conditions. The internal conditions describe the strengths and weaknesses of the project and the external factors describe the opportunities and threats of the project.

In the civil engineering industry of Manado a SWOT analysis is used to identify the charactaristics of an area. When it comes to unique problems and solutions it is a rare instrument that is used by the government to come up with additional requirements or necessary changes to make the perfect design. The vision and mission of Manado set besides these clear and great challenges a nuanced set of strategies, which were not really SMART in the way of Ambitious and Realistic.

Internal analysis

The internal analysis is a tool in the investigation of the strengths and weaknesses of a public organization or private company. By this analysis, a clear and convenient enumeration is stated to show and compare the characteristics of the plans.

Strengths

The Vision and Mission have a strong internal political support and therefore the risk for internal struggle is reduced. With these clear and optimistic quotes, the Municipality of Manado creates a progressive and enthusiastic atmosphere people believe in. Externally the common goals have been seen as positive from several stakeholders (Environmental groups, tourism industry and the citizens of Manado City). Any form of resistance by other parties is therefore almost reduced to zero.

According to the latest figures, 26% of the economical structure is for the tourist industry, Hotels, Restaurants and Cafés. This recreational sector is since 2003 the largest business, in front of the trade sector, in the city centre as well as the surrounding areas of Manado. From that point of view it is a good starting point to develop the city by implementing the Eco Tourism Model. Even so is the Bunaken National Park a perfect example of how the use the existing possibilities. This beautiful coral riff is one of the world's most respected diving spots, which will have a positive impulse by the measurements.

The Eco character of the Vision is a strong marketing tool for the tourist industry. People from around the globe will see Manado as a green city and because of the sustainable hype that arose the last couple of years, the city will rise on attractiveness. This also count for the additional Eco Friendly Engineering, a reduction of the CO2 emission and the use of sustainable materials put Manado on a higher scale of environmental thinking.

Weaknesses

The planning of Manado City has a high density of 2.686 people/km2, with almost only low buildings. This results in a fully packed city and also the hills around the city, creates a high difficulty to reach the goals that they have in mind, a city of happiness. According to the survey among the youth of Manado the most annoying aspects in Manado are the traffic jams, garbage, lack of pedestrian lanes, no green areas inside the city to relax and the additional public facilities.

The plans for the future of Manado are a perfect match to the demands of the citizens and vision of the government, but these measurements are vague. To provide the inhabitants of the city with the information they need according to the chances that the government want to implement, a clear explanation is necessary. Under the people there are questions about the meaning of Eco Tourism and what the benefits are for them.

Besides the lack of information to the people a real business or master plan is missing. Transparent documentation of all the measurements is not available for everyone who want to understand what is going on. This closed form of management creates a resistance from the citizens who definitely will be affected by the plans.

External analysis

The opposite of the internal analysis is the external one. These so-called macro-environmental analysis focuses on the local to worldwide influences. This part elaborate the uncertainties that might occur when the measures are implemented, in opportunities and threats.

Opportunities

A large increase of economic impact by diving tourists in Bunaken en Siladen. These dive spots are well known by especially professional divers because of its beauty and diversity of coral and fish. When the area of Manado improve their character to an Eco Tourism City, the news of a clean and sparkling dive place will go across the world and attracts more and more divers to the islands.

When the green eco friendly label is placed on the area of Manado, people from every corner in this world will come to Manado to see it by themselves. Besides the Bunaken National Park, it’s clear that there will be an increase of the demands by tourist in and around Manado City. For example the Tondano lake, safaris to the inlands of Minahasa, colonial sightseeing, ect. will give an economical impulse to the city as well as the region.

Other cities in and outside Indonesia will use Manado as an example when they implement an eco friendly image. This will improve the attractiveness of Manado for public as well as private parties, like investors. Even so the international relations increase, when delegations of foreign cities come to Manado. All these prosperities end up in a city of happiness where the citizens are proud to live in Manado, so they will not move to another city for work or living.

Threats

The implementation of Eco Tourism activities requires a large investment, needs monetary funding and depending on how this is gathered there is a risk that the support for the project could be damaged making the project more difficult to pull trough. By telling the people unrealistic goals they will lose their faith in the current Mayor and staff because they cannot achieve what they proclaim.

The whole city needs to improve, to a city of happiness with the Eco Tourism character, and not only the best and developed parts. It is a common way of developing areas where the advanced sectors receive extra attention in relation to the inferior areas. Especially in Manado it is ordinary to pay a lot of attention to visible sides and leave the rest untouched. This will end up in a gap between different parts of the city with all kind of consequences.

Some of the measurements are a copy of interventions from the western world and can have a negative outcome for the city of Manado. Manado is not a western city and need therefore to consider the implementation of custom-made solutions. Due to the weather, soil conditions and other geological differences, also the culture and financial capabilities creates the need for an unique solution. Otherwise some measurements can be very costly, while other solutions have the same outcome and fit much better in the regional environment.

A well known threat in change management is the resistance against changes. Men are creatures of habit and have difficulties to adapt to variable changes. When it comes to their own mindset, for instance the garbage, they need to see their personal gain before they will ever change it. The same applies to the NIMBY (Not In My BackYard) effect, which indicates the resistance against interventions that will harm a small amount of people for the greater good.

Confrontation matrix

The picture below shows a summary of the internal and external analysis.

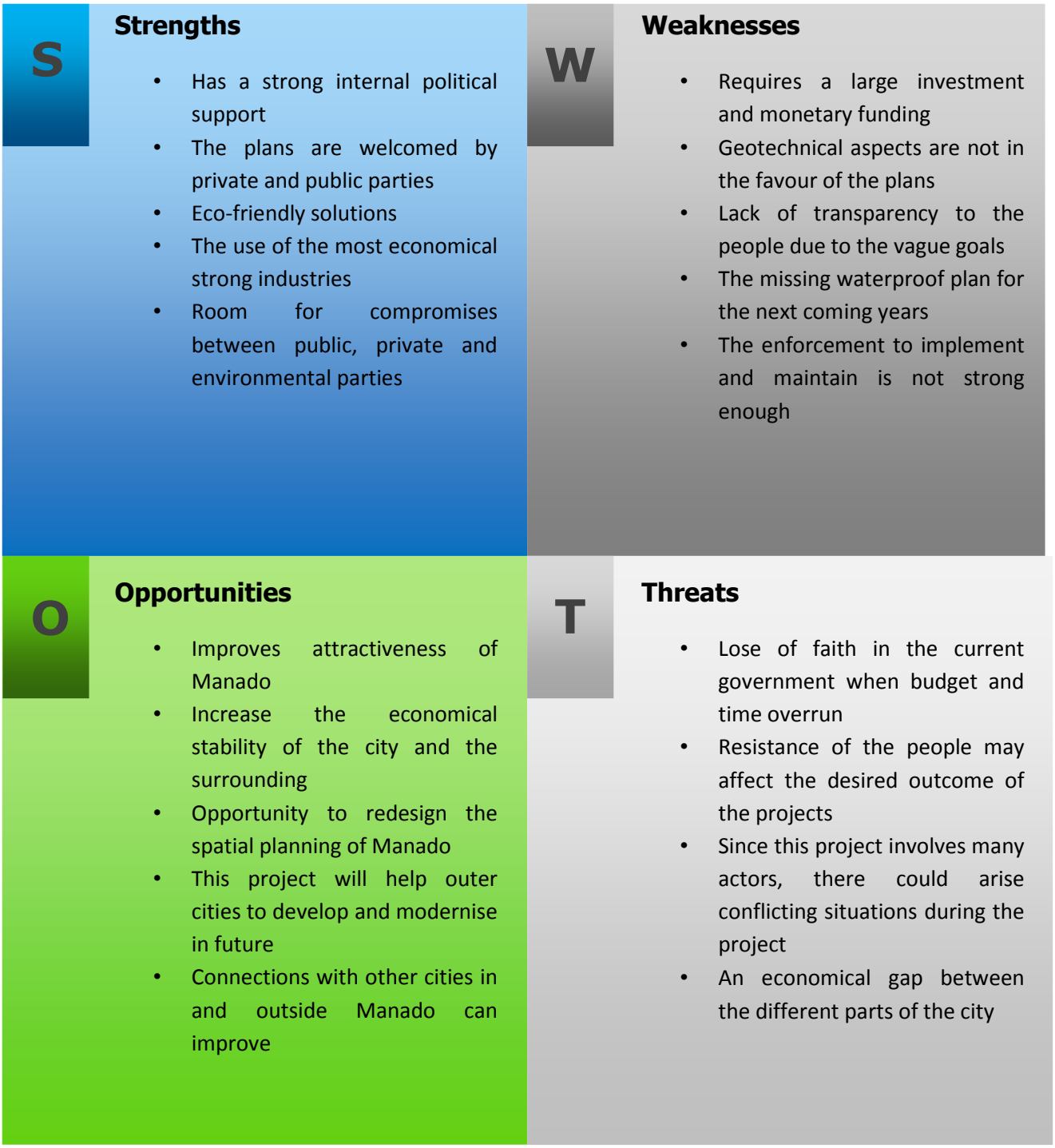


Figure 5: Confrontation matrix

Issues

The strength of the marketing tool can be exploit during the implementation phase. When the world is aware of the high degree of development in the region of Manado a first stroke is given to attract tourist and investors. A proper marketing department is needed to put Bunaken and Manado on the world map.

Internal support creates a positive charisma of the city to the outside world. This will be picked up by other cities in and outside Indonesia so they can implement the green thinking in their own city. Small and large cities try to equal the example given by Manado City with all kind of beneficial advantages. To reach this positive charisma, the citizens need to be aware of the plans made by the municipality, so they can make a contribution by talking to people in other cities.

When possible solutions come to the table to solve unique problems in or outside the city, the use of local characteristics are needed. There is no need to re-invent the wheel so examples from abroad can be exploit but with the short comment that Manado is not a western city. Every solution need to be investigated on the feasibility of the city by the use of their own strengths. Successes from other cities are no guarantee for the implementation in Manado.

As the city of Manado is situated on the hills, it creates a difficulty to improve the whole city. On the other hand several problems can only tackled when certain areas, located in the hills around Manado are recovered. Therefore is it important to let this operation succeed by involving all districts. In fact it can be said that the improvement of these areas have a higher priority, for the main reason that a lot of garbage is from this part of the city.

Strategies

The enforcement in relation to the implementation and maintenance of the measurements has to be strengthen. The laws and regulations according the civil engineering industry are not guidelines but strong rules that has to be complied. Room for negligence is not longer possible.

Create a powerful marketing approach to inform as much people and private parties in different countries about the plans and future of Manado. Social media is an upcoming medium to provide the world with all necessary documentation. Invent new ideas that attract people and especially non-divers to the city, like sport events and youth organizations. Everyone who is aware of the opportunities that arise when the vision and mission are implemented in the city will be involved whether today or tomorrow.

All available data has to be collected and analyzed to make custom-made solutions for every problem. Examples from other cities can be used but need the necessary investigation to use it in the city of Manado. Therefore must the city organize and monitor data collection of all sort of natural appearances, starting today.

Involvement of direct and indirect parties. Use the knowledge of process management to make sure that the internal support will be there, in good times and in bad times. By mapping the stakeholders, a clear view on their interests gain information how to handle. Also the feasibility needs to be reconsidered, the goals sounds fantastic but is not really according to the SMART principle. The realistic and measurable aspects are doubtful.

2.4 Stakeholders analysis

One of the first steps in managing stakeholders, is to map their interest and in the project. The essence of the technique is to identify the perceptions that stakeholders themselves hold in order to identify potential levers for action. Once the stakeholders map has been drawn up, the power/interest grid can be used to develop a strategy towards managing the different stakeholders.

A good process is an open process, in which parties' core values are protected, which has sufficient incentives for speed and offers sufficient guarantees for the substantive quality of the results. The most important process design principle is that this design for a decision-making process is transparent. Transparency means that the course of the process is clear to parties, how their interests will be protected, what decision rules will apply, and who will be involved in the process.

The plans for the transition of the city of Manado, to an Eco Friendly City, are in an early stage, and are known by a few parties. These parties are in general the parties in the partnership of the Municipality of Manado. This partnership contains other governmental agencies and organizations. The need of an analysis is known but underestimated by the legislators of Manado. It should be in every project that is initiated by public and private parties. Beside the fact that the implementation of a stakeholder analysis reduce the resistance by other parties, they can and will also apply ideas to solve the problem. Most of the times the stakeholders are directly involved and thereby know the area very good.

Stakeholders

In the process there are different stakeholders involved. The initiative of the project lies with the municipality of Manado. The capital and largest city of North Sulawesi with an estimate of 422.653 inhabitants falls under the direct responsibility of the governor of North Sulawesi, Other parties must be taken into account, especially because of future planning around Manado, like Minahasa the area around Manado and the Province.

The main vision, "Manado, Model City of Eco Tourism" and mission, "Make Manado a City of Happiness" will particularly affect the residents alongside the river banks, city centre and coastline, but also other actors will have an interest or a vision on the plans recently brought to the table. To gather information about the different views and interests, interviews are conducted with parties involved.

Regional

The municipality of Manado desires that especially the main strategies will be executed in order to accomplish the goals set in the vision and mission; they want to solve the current garbage problems and in addition several other underlying problems to develop Manado City. The interest of the municipality of Manado lies with the improvement of the Eco Tourism and feelings of the citizens about the city. The municipality wants to create a closing garbage network to collect and cope with all the plastic that is used by the people.

In the opinion of the Minahasa region, Manado is the party with most opportunities in the region. They believe that when the city of Manado will grow on an economical base the total region will benefit. Even so creates the development of Manado new jobs, so the workforce of the Minahasa region can be used. In addition will the infrastructure between the small villages of Minahasa and Manado improve. But in fact they have no power to implement any of their ideas about the region and especially Manado City. The internal structure of the governments is complex, while they want to achieve a common goal, economical growth of the North Sulawesi Province.

This is why the Province of Sulawesi Utara support the vision and mission of Manado City. Their capital needs to epitomize the region and maybe even the country. Even so creates a economical growth more power for the province and larger funding from the national government. A substantial increase of the province is also in their favor.

Districts

The district represents its inhabitants and other small action groups of the municipalities. The city of Manado is divided nine kabupaten: Malalayang, Sorio, Wanea, Wenang, Tikala, Mapanget, Singkil, Tuminting and Bunaken and 87 villages. They look after the interest of the residents, catering and shop owners in the different areas Manado. The council has formally no powers but they're taken into account for the plans in the area. As an assumption the coastal district are combined as one group and the districts of the inlands because they experience the same interests and problems.

The coastal districts see a lot of benefits by the implementation of the vision and mission. Especially the entrepreneurs in the tourist industry of the districts are positive about the plans of the municipality. They see a lot of benefit for their sector as well as the development of the whole area. The attractiveness of the city will improve the amount of tourist to the city centre and the islands of Bunaken. Besides the increase of the primarily income also the secondary industry in the form of restaurants and shops are willing to support the plans of the municipality.

The inland districts have a slightly different opinion about the plans. As citizens of Manado they see the need of a development but see almost no benefits when the plans are implemented. They think it is all about the developed regions on the shore of Manado which will experience economical growth while they have to pay for the transformation. They need to change their habits to clean up the city but an improvement of the tourist industry will not give them prosperity.

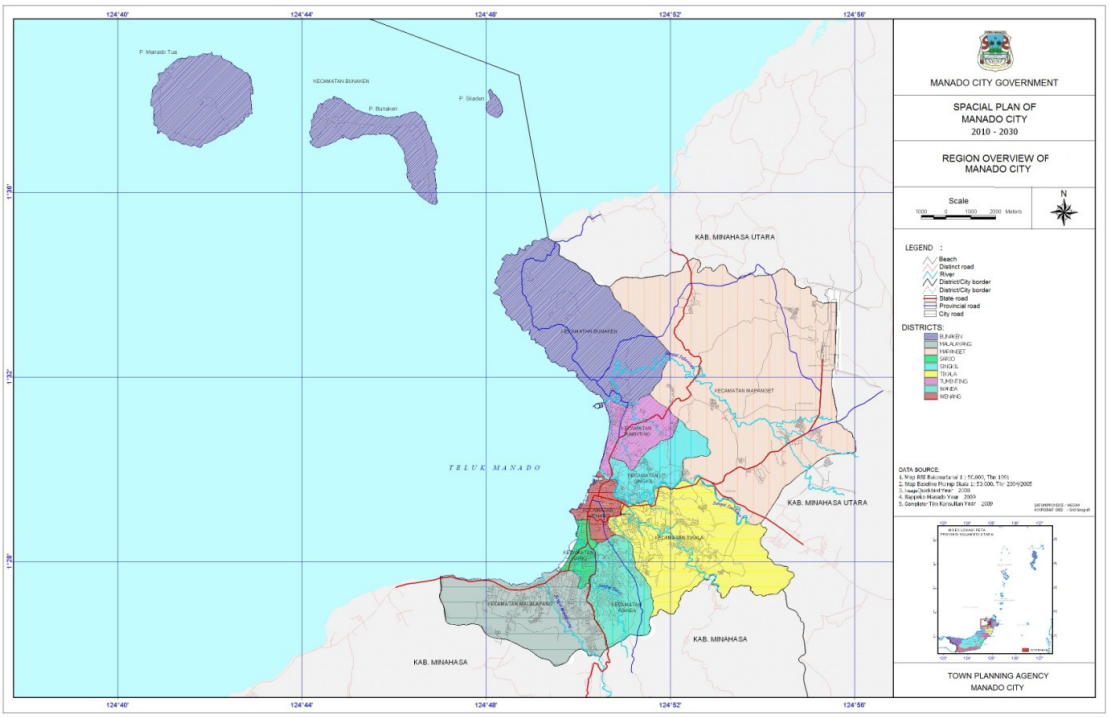


Figure 6: Sub-districts of Manado City

External

The economical development institute of the area of Manado sees a lot of possibilities when it comes to a substantial growth of the city, in detail the tourist industry. Several investors are willing to participate in the vision and mission of the city, unless the plans gives a bright view on the prosperity and the reduction of corruption. Till that time they act laid back.

Also the environmental groups sees a lot of benefits in the vision and mission of the municipality. Every form of Eco Friendly development is a win for the nature. There plans goes even further than a Eco Tourism City. If it is up to them the city of Manado implement a CO2 neutral standard and award the use of sustainable materials.

National

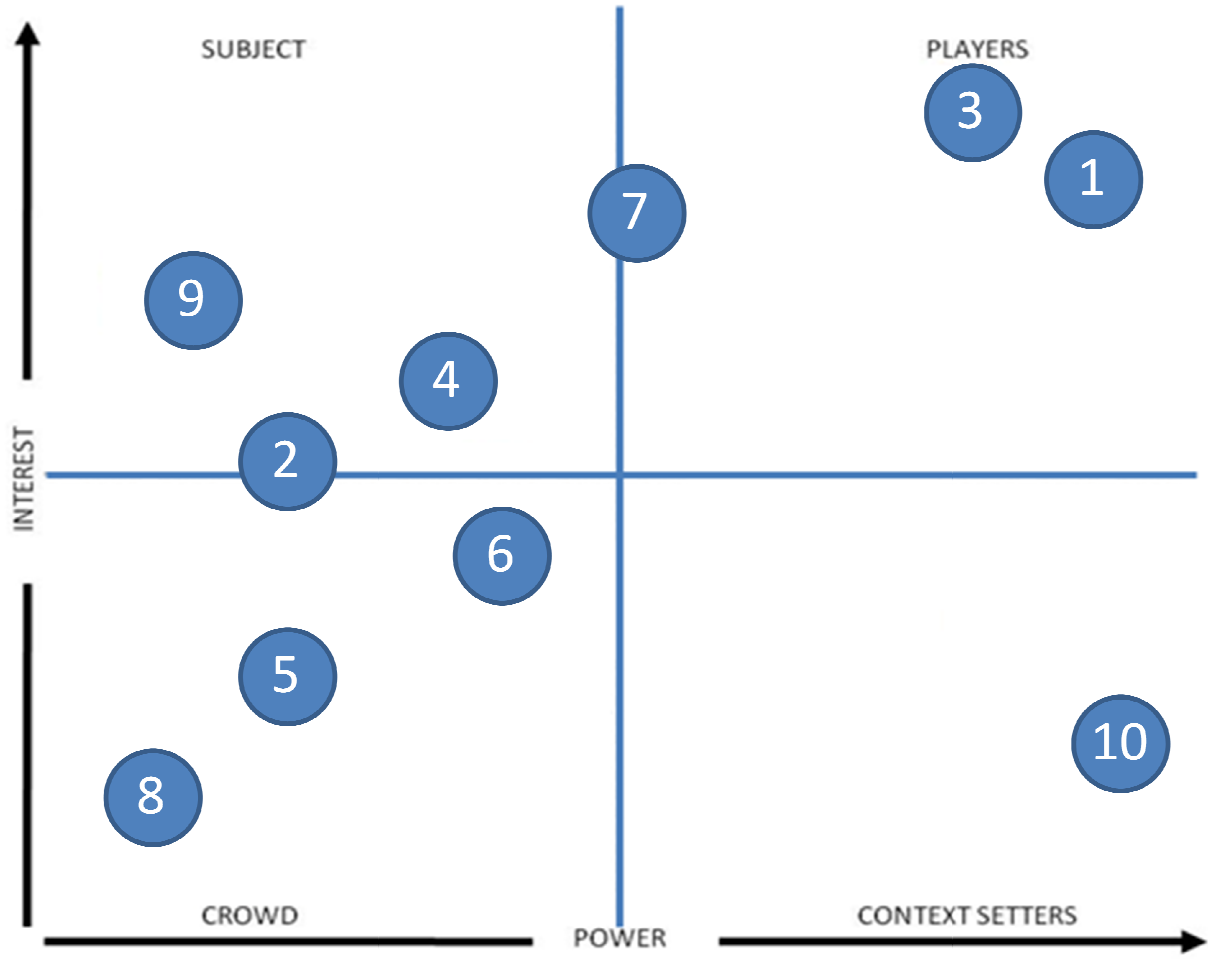
The national Government in Jakarta only care about the overall planning. The municipality's vision and mission should match the national plans of development. The municipality of Manado gets its funding from the national government, also called the APBN, a national budget plan that provides a wide spatial-purpose grant to provinces and regional public bodies for the implementation of an integrated development policy.

Power interest grid

The indication of stakeholders clarifies the different positions of the several parties that are involved in the development of Manado. To get a good indication of the power and interests of each party involved, it is wise to get a good overview of the different stakes. Therefore it is important to have an insight into the resources of actors, since these largely determine the influence actors can use to realize their interests. Resources may be for example, funds, authority, knowledge or reputation. A special resource is an actor's network of relations. The more relations an actor has, the more possibilities he has of gaining support among other actors.

An important case in decision-making is also the fact if an initiators relation with an actor is repetitive. If they will meet again in the future good cooperation with this actor is important. The sum of resources, relations and the repetitive character of relations lead to three types of power positions, production power, blocking power or a diffuse power position.

Production power means that an actor can make a positive contribution towards the realization of a project. Blocking power means that an actor can only halt a project and a diffuse power position means that it is unclear to an initiator what the power position of the actor is, that this position may change or that it is unclear whether an actor will want to use his resources and relations.



1. **Province of Sulawesi Utara**
2. **Minahasa region**
3. **Municipality of Manado**
4. **Coastal districts**
5. **Inland districts**
6. **Entrepreneurs**
7. **Investors**
8. **Tourists**
9. **Environmental groups**
10. **National government**

Figure 7: Power vs Interest grid

The most important group is the players, stakeholders who have most power and interest in the process. It can been said that local and regional government authorities have the biggest interest and power in almost all processes, the public civil engineering constructions, as these so-called key player set up the project itself. The other party who is able to initiate projects are the investors. The fact that there is no spatial planning, everyone can make a proposal for a new construction. The influence this group is so large as they control the process and money flow to reach the expected outcome.

Next to the players of the project, the 'context setters' are very important in a project. These are the stakeholders that can create risks in the project. This because a stakeholder in this category can use their blocking power and have so the ability to block the process. As said, these stakeholders have a lot of power compared to the interest they have in the project. For this reason it is very important to take these actors into account to protect the process for delays.

Next to the powerful stakeholders, there are also the stakeholders with less power but high interest in the project. These actors could be categorized as the 'subject' of the project. As said, these actors have less power, but can give good input based on the interests they have in the project. These stakeholders can be very usable to get inspiration from to improve the design process of the project. Next to this, these stakeholders have to be updated about the proceedings of the project.

Finally the 'CROWD' are the stakeholders that may have some interests in the plans, but have the position with less power in the project. This category has, as well as the subject, to be updated about the status and process of the work.

Network

Stakeholders work within relationships, a network of actors around them. Relationships are the human operating system. In order to make our lives and our work successful and fulfilling, we need to apply the natural principles of relationships by establishing the values, structures and the processes of relationships throughout the organization.

Affirmation is fundamental to healthy and productive relationships. Affirmation is the most elemental of all values. It encourages, builds, enables, empowers and ensures the fulfillment of each individual in the organization. It encourages calculated risk. Affirmation enables mistakes to fuel a learning culture instead of a blame culture. Our affirmation of ourselves and others is the most significant factor influencing the structure and the processes of our relationships.

The concept of involving people in the matters that affect them is a well-accepted principle of leadership and management. Involvement is a powerful value that affirms the unique contributions of the individual, increases ownership. Involvement unlocks enormous potential through synergy and allows organizations to implement change more effectively.

During the weeks of research, the network relation of the different governmental agencies isn't clear enough to show. Mutual relationships are present but when money and responsibilities play an important role, agencies idolize themselves or blame the others. The representation relations are only there in the form of influence relations, a party that represent another depends on the power of the parent party. These findings indicates that it is too complicated and something needs to be done. Several civil engineering projects have been investigated and every time the responsibility of the investment and outcome is diverted over different governmental agencies. In order to manage the implementation smooth, clear distinguishes are needed.

2.5 Design

When the business case is finished, the scope is fixed so a design can be made which will fit in the problem analysis. An important process design principle is that this design for a decision-making process is transparent. Transparency means that the course of the process is clear to parties, how their interests will be protected, what decision rules will apply, and who will be involved in the process.

By tender a company is appointed to design the total project. During the design phase, the company collect the necessary data. In a lot of projects from the past it is known that because of the lack of proper data an assumption is made on the basis of expertise and data from the old days. In addition to the fact that after the design is approved by the government, the company who made the design will be responsible for any mistakes. It goes even further, the man or woman that placed the signature from the company is personally responsible for any disadvantage of problems with the design. Even when the government approved the design and tendered it to a new company.

As the management of the initiation phase describe, should the design match the laws for civil engineering, any adaption for these guidelines are very rare. For the period of the design there are opportunities for Public and Private parties come together to discuss about small adjustments and needs and demands that required the best solution. It is said that all parties are equal but by talking to a lot of people it sometimes slipped through that the people with power or money will have a larger vote.

2.6 Financial feasibility

Financial feasibility is the last step to complete the business case, initiated in the first paragraph. According to different people economical aspects are investigated. In forms of alternatives the companies can calculated and adapt to variation in the economical sector. They have to deal with those uncertainties by themselves and there is no way the government will approved contracts which contain anything like compensation for hyperinflation or other financial disadvantage by economic decline.

Revenues

In addition to occur in stages in the area of government administration, the benefits of a construction project execution also occurred in the category:

- Direct benefits;
- Indirect benefits.

Direct benefits will directly enjoyed by economic agents due to commencement of construction project implementation work, both at the stage work of Survey Investigation and Design (SID) which is enjoyed by perpetrators of economic *consultants,* and at this stage of the work of the construction and operation enjoyed by Directors of the Contractor and Project Owner, ie: State-Owned Enterprises (SOEs), Regional-Owned Enterprises (enterprises) in the county or city, or owned, privately-owned Persero individuals or groups of investors.

Direct benefits resulting from implementation of the work of construction projects are:

- Insurance underwriting jobs;
- Bank interest and capital of the trip;
- Administration Fee;
- Trade transaction fee material resources / materials;
- Wage employment of professional expertise;
- Wage labor jobs / labor;
- Fee or profit consulting firms and contractors;
- Fee of trading activities / consumption at the level of job sites.

Indirect benefits that come forward of the result of construction work is associated with improved quality of community life and the environment after the project was constructed and then operated.Indirect benefits, according to the theory of economic evaluation aspects of the project due to social and externality aspects.

Development consisting of a wide range of activities aimed at, among other things, animate and improve economic activities resulting in economic growth. Economic system that embraces the law of market economy provides benefits in stages at each of the implementation of economic activities, namely at the level and location of economic actors respectively.

For example, when the planning and implementation of the project Building Safety Beach North Minahasa regency and the city of Manado placed in sequence, then the benefits will come forward. Not just around the local coast municipalities, but also Jakarta comes forward in which case a place of central planning of the direct benefits. Hard money flow is more important than the indirect benefit, improvement of nature, because the economical growth of the city has a higher priority. When every rule based on the environment will be held, any form of property will degrease. They were aware of the fact that the reclamation area's have a negative outcome for the Bunaken but have a huge financial benefit for the government and therefore for the whole region. Green thinking is just beginning but as been seen in all underdeveloped countries the prefer to make money instead of preserving nature.

2.7 Procurement law

The legal regulations on procurement, especially those concerning governmental actors, have far reaching implications for the possibilities to develop network relations. Three principles that are useful in the construction industry of Manado are explained. The reason for these principle is a result of the conclusion given in the management style paragraph.

As stated in the management approach of processes, the transition from hierarchical to a network style is desired to create a more transparent and environmental atmosphere. When the city of Manado is willing to implement this more stakeholder oriented approach in the construction industry, certain principles need to be reconsidered. These principles make sure that the market competition remains and necessary data is available for all parties.

Non-discrimination principle

The non-discrimination principle, requires the equal treatment of an individual or group irrespective of their particular characteristics, and is used to assess apparently neutral criteria that may produce effects, which systematically disadvantage persons possessing those characteristics.

When a public party has a good understanding, because of experiences in the past or familiar relations for example, with a private party, they are not allowed to exclude other parties. When another private party, in the construction world a contractor, has the best selection criteria they must get the job, because of the principle that every contractor should get a fair chance to win the tender.

Transparency principle

The transparency principle, is one of the foundations of excellence in manufacturing and a fundamental step to construction companies searching for excellence in their production systems. It can be simply defined as the ability of a production process (or its parts) to communicate with people. It is a move from the usual silent production process to a more communicative one.

A contracting entity has to answer questions about the project content in such way that not a single tenderer could be more informed compared to his competitors. So when an answer is given, the answer and the question have to be publicly communicated to all the competitors. This limits the willingness of the tenderer to ask specific questions about the possible adaptability to the contracting entity because his plan would be instantly be revealed to his competitors.

Chinese Wall principle

The Chinese Wall principle, is a barrier that separates two or more groups, usually as a means of restricting the flow of information. Typically, the wall is purely conceptual, although groups may be divided by physical barriers (areas of a building, for example) as well as policies.

When a company made the design for a building, they will be excluded from the tender, because of the extra knowledge they have in advantage of other tenderers. So by this principle it is not possible to create a network relation during the whole project. There has to be clear distinguishes between the parties who are have to knowledge and who don't.

3 Project Management

When all the business case is ready, the next phase appears. Project management, an unique and clearly delineated management discipline with clear goals and requirements. The total control of budget, time schedules, labor, organization, information flows and quality are the main tasks to make operational decisions. The actors and stakeholders are known in this “frozen” context.

3.1 Project delivery system

According to the above chapter, a proper solution needs to be found to collect enough funding so the vision and mission of the Manado City can be executed. These funding have a strong relationship with the contract forms that will be used. The design of a contract gives room for external investors to cooperate and gain financial benefits from the implementation of the plans, written by the Municipality of Manado.

In the business of civil engineering there are a lot of different contract known. In Manado the common way for a contract is the traditional one, due to the fact that a strong hierarchical approach is desired. Besides this traditional manner a Public Private Partnership is introduced to supply the citizens with drinking water. The company of Waterleidingmaatschappij Drenthe NV offered a couple years ago to have a contract with the authorities for the development of drinking facilities in the city of Manado.

All contracts are elaborated to give an overall view on the possibilities regarding the need for funding and mutual understandings. These type of contracts are based on the European procurement laws and regulations. In the last couple years a transformation could also been seen in Holland, the traditional way of building, with fixed responsibilities and designs are replaced by more and more stakeholder oriented approaches. This also had to be recorded in new forms of contracts.

Traditional

The traditional contract between Principal and Constructor is a contract with fixed amounts of construction details. When the design is approved by the Principal, they write out a tender to encourage different companies to calculate the total sum of money to construct the design. The company that will win the tender will build exactly what has been written in the contract.

Any additions to the contract, when the design is not accurate about the total amount of materials the construction company collects the money that has been calculated for that material per unit. Even so is written in the contract that financial penalties will be given for each day the project delays. At the end of the project, the company hands over the construction to the Principal who will, after the approval take care of any form of maintenance.

Building Team

A **joint venture** is a business agreement in which parties agree to develop, for a finite time, a new entity and new assets by contributing equity. They exercise control over the enterprise and consequently share revenues, expenses and assets. There are other types of companies such as JV limited by guarantee, joint ventures limited by guarantee with partners holding shares.

The venture can be for one specific project only - when the JV is referred to more correctly as a consortium (as the building of the Channel Tunnel) - or a continuing business relationship. The consortium JV (also known as a cooperative agreement) is formed where one party seeks technological expertise or technical service arrangements, franchise and brand use agreements, management contracts, rental agreements, for ‘‘one-time’’ contracts. The JV is dissolved when that goal is reached.

A joint venture takes place when two parties come together to take on one project. In a joint venture, both parties are equally invested in the project in terms of money, time, and effort to build on the original concept. While joint ventures are generally small projects, major corporations also use this method in order to diversify. A joint venture can ensure the success of smaller projects for those that are just starting in the business world or for established corporations. Since the cost of starting new projects is generally high, a joint venture allows both parties to share the burden of the project, as well as the resulting profits.

Since money is involved in a joint venture, it is necessary to have a strategic plan in place. In short, both parties must be committed to focusing on the future of the partnership, rather than just the immediate returns. Ultimately, short term and long term successes are both important. In order to achieve this success, honesty, integrity, and communication within the joint venture are necessary.

Integrated

Design and Construct (D&C) is a slightly new project delivery system in the construction industry. It is a method to deliver a project in which the design and construction services are contracted by a single entity known as the contractor. In contrast to the traditional contracts, D&C relies on a single point of responsibility contract and is used to minimize risks for the Principal and to reduce the delivery schedule by overlapping the design phase and construction phase of a project. Because D&C, with its single point responsibility, carries the clearest contractual remedies for the clients, the contractor will be responsible for all of the work on the project, regardless of the nature of the fault.

The traditional approach for construction projects consists of the appointment of a designer on one side, and the appointment of a contractor on the other side. The D&C procurement route changes the traditional sequence of work. It answers the client's wishes for a single-point of responsibility in an attempt to reduce risks and overall costs. It is now commonly used in many countries and forms of contracts are widely available.

Design-Build-Finance-Operate-Maintain (DBFOM) approach is a contract form when the responsibilities for designing, building, financing, operating and maintaining are bundled together and transferred to private sector partners. There is a great deal of variety in DBFOM arrangements in the United States, and especially the degree to which financial responsibilities are actually transferred to the private sector. One commonality that cuts across all DBFOM projects is that they are either partly or wholly financed by debt leveraging revenue streams dedicated to the project.

Direct user fees (tolls) are the most common revenue source. However, others ranging from lease payments to shadow tolls and vehicle registration fees. Future revenues are leveraged to issue bonds or other debt that provide funds for capital and project development costs. They are also often supplemented by public sector grants in the form of money or contributions in kind, such as right-of-way. In certain cases, private partners may be required to make equity investments as well. Value for money can be attained through life-cycle costing.

Alliances / Partnering

Public–private partnership (**PPP**) describes a government service or private business venture which is funded and operated through a partnership of government and one or more private sector companies. The integrated contracts seen in the previous paragraph can also be seen as a PPP. Public-Private Partnerships come in a variety of forms and no two PPP projects are exactly alike.

PPP involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project. In some types of PPP, the cost of using the service is borne exclusively by the users of the service and not by the taxpayer. In other types (notably the private finance initiative), capital investment is made by the private sector on the strength of a contract with government to provide agreed services and the cost of providing the service is borne wholly or in part by the government. Government contributions to a PPP may also be in kind (notably the transfer of existing assets). In projects that are aimed at creating public goods like in the infrastructure sector, the government may provide a capital subsidy in the form of a one-time grant, so as to make it more attractive to the private investors. In some other cases, the government may support the project by providing revenue subsidies, including tax breaks or by providing guaranteed annual revenues for a fixed period.

Manado tries to implement the main vision and mission of the city. To achieve these common goals a proper delivery system is needed. In the western world the environment plays an important role during the tender phase. Beside the traditional financial bid, a fictional discount is possible when the total score on the EMBT (Economical Most Beneficial Tender) is significant. This score is based on the environmental aspects as traffic congestion as well as the reduction of the CO2 emission.

3.2 Tender

In Manado at first there is the announcement of a new project. This is done through advertisement, to make one and another aware of the demand. Within the tender the specifications are fixed by the project owner. The tender can be joined by all kind of companies. Although there are certain demands. For the tender there is a minimum number of 3 competitors needed. Each competitor needs to have 4 years experience in the area in which the project will take place. A company can only attend the tender if they have developed a project in the past which had a minimum value of $^1/_3$ of the current projects budget. This budget is stated by the client.

Project with a budget beneath the 50 billion IDR only local contractors can attend. If the budget is higher, also international companies can attend. Mostly this is not only a requirement, but also a need. Given the minimum of 4 years of experience and a history of projects where the budget is at least $^1/_3$ of the current budget.

Contractor that will win the tender needs an insurance of 20% on their bank account which the government blocks. It is equal to the amount of down payment, so the contractor has enough money to start the project. Sometimes the companies will work without owning this 20% of finance.

Bid

Usually the best bid, mostly the least expensive one and with the best characteristics, gets the project. Since 2008 this process is all digital. Companies log in online with their own ID and password. At the website they can upload their documents. Results are also presented online. When one has uploaded his tender, he/she will see the tender others have attended.

Specifications are defined by project owner. Governments also state standard prices for certain activities. During the tender the project owner has assigned a maximum pricing to the project for which the attending companies have to make the structure. Bidding is based on the defined specifications. Tender documents, do the documents and prices match the upload. He can also give some explanation. Prices are based on daily pricing and based on the required volume.

Certificates

These criteria play a role at the point of the restricted procedure and when inspecting all the tenders. In other words at the selection stage. The winner is the party which is meeting the criteria and the most economically advantageous tender the best. The contractor makes a clarification with the client. During this clarification the contractor shows his;

- List of educational/professional qualifications;
- A list of works carried out over the last 5 years;
- Statement of tools, plant and technical equipment available for work;
- Average manpower;
- Statement of technicians and services.

3.3 Preparation

The bid has won and the company fits in all the necessary documents, the preparation can start.

Planning

A planning like it is in the western world will be made with MS project. The total work break down structure forms the basis of the input for the planning. Every activity is linked to another activity with fixed time schedules. The planning will be used to predict the expected date of delivery of phase one of the project. The planning has the ability to predict the expected date, but is unable to manage the project on the go. This is caused by the fact that in a planning the ideal precedence of activities is simulated which do not change during the execution of the project. In reality this is hardly ever the case, activities do changed in sequence and length during the project.

The critical path calculates the longest path of planned activities to the end of the project, and the earliest and latest that each activity can start and finish without making the project longer. This process determines which activities are critical and which have total float. In project management, a critical path is the sequence of project network activities which add up to the longest overall duration. This determines the shortest time possible to complete the project. Any delay of an activity on the critical path directly impacts the planned project completion date. A project can have several, parallel, near critical paths. An additional parallel path through the network with the total durations shorter than the critical path is called a sub-critical or non-critical path.

Purchase of materials

Construction can take a long time. Within this construction time material prices can vary greatly. Only when a project takes more than one year to complete there will be a second consideration of the pricing. The consideration is done by the government. Additional budget is commonly about 10% of the projects budget. Most of the times the consideration is demanded by the contractor. This is why contractor usually benefit from this consideration, although the consideration only takes the residual process into account.

Safety plan

As seen in the project process part, before one project can start, there is a tender phase. In this phase safety regulations are already present. Aspects related to this subject are written down in the Bid and are stated in Certificates. Safety control is executed by the contractor, which is thereby also responsible if something goes wrong. Governments can check the safety control at the site. Per project it depends if there is a fine or not. Before a contractor starts to build he contacts an insurance company. This company pays for health costs of workers for the time the project takes place. Safety rules depend on the project owner. In case of a foreigner or private party the rules are really strict but when the local government is the Principal there are hardly no rules according to safety.

In the world of construction in Manado there are regulations according to the safety of the people, but the observance is not there. The last couple years, Jakarta put some pressure on these aspects to protect the workforce, but till today these safety rules are not implemented in the construction industry. One can already expect that safety control differs between local contractors and foreign contractors. E.g. employees of a Japanese builder get a fine and are fired if they don't wear their safety equipment. However is a employee of a governmental project does not wear his safety equipment there will be a warning, but there is more acceptance.

Risk management

Next to the SWOT analysis in the process part, a proper risk analysis is useful. The threats are possible problems that might occur when the measurements take place. Risks are a common aspects in projects as well as in processes by the development of an area. The management of these risks contains the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events or to maximize the realization of opportunities. Risks can come from uncertainty in financial markets, project failures (at any phase in development, production, or sustainment life-cycles), legal liabilities, credit risk, accidents, natural causes and disasters as well as deliberate attack from an adversary or events of uncertain root-cause.

The strategies to manage and mitigate risks include transferring the risk to another party, avoiding the risk, reducing the negative effect or probability of the risk, or even accepting some or all of the consequences of a particular risk. Certain aspects of many of the risk management standards have come under criticism for having no measurable improvement on risk, whether the confidence in estimates and decisions seem to increase. During the preparation phase of a unique project, any form of risk management is not used very often by the construction companies in Manado. Risks that occur during the execution of the project are problems that arrive by the time being. The point of view on this matter is that risks not manageable because they are uncertain.

3.4 Management Style

The most common management techniques are describes as the PI and PII management styles. The main difference between these two major management techniques is the method that says something about how to deal with stakeholders and their constantly changing interests. [2] To get a clear view of what the differences are, first the two approaches will be explained in the following sections.

PI management

The first approach that can be interpreted as the management style that focus on how to avoid overruns in time and money. By setting and determine goals in the beginning of the project and not changing them during the process, this management style is attractive for projects where the scope is clear and simple. This means for instance that it is less attractive for innovative projects, where a lot of complexity dominates and future goals and determinations are difficult to predict. The principle of an PI approach is that a design will start from an arbitrarily chosen first design. Adjustments will be achieved during the process by the trial-and-error principle. Standardization could be applied as it could reduce complexity. These standardizations will be implemented by the principal.

To be in control of all the aspects that are related to the project, the planning is fixed and authorized by the principal and is therefore leading in the project. Additional interests and demands will end up in a delay and extra costs. For this reason, the management style has a hierarchal organization, where the project manager steer and decide in the project. It means that in difficult and conflicting situations, the most powerful stakeholders in the hierarchical top will decide and compromise the solutions for it.

For the communication and persuasion of players in the project, it means that everyone has to keep informed about the design status, approved changes and planning. This will mostly be done by presentations to convince players who have to accept compromises. For the planning it means that this style will divide process into small steps with identifiable milestones against deadlines.

PII management

The second approach can be interpreted as the management style that focus on projects with an high complexity rate. It is an management style where nothing is fixed in advance, so it is prepared to adjust goals when circumstances change and so insight can be improved. Instead of the hierarchal organization in the PI approach, the PII approach has a more network related approach. This means that the stakeholders interests are centralized and will function as the leading system in the decision-making process. This network related process means that it is dynamic and closed to hierarchical signals.

To create this network-oriented mind-set, it is important that actors have to think in roles rather than tasks. This means that there has to be worked with broad job descriptions. In the PII management principle it is important to create a climate for mutual adjustment of tasks.

PI versus PII management

To get a clear view of the differences of the two approaches, a table is set up with the different aspects of the styles. These aspects will be explained shortly in the specific column. These differences are illustrated in table 1 beneath.

	PI	PII
Goal Setting	Before awarding contract design should be frozen and not be unfrozen before commissioning	Nothing is fixed in advance, be prepared to adjust goals when circumstances change and insight improves
Leadership	Leadership provided by the project manager	Leadership aimed at defending relevant stakeholders interests
Conflict resolution	Focus on powerful stakeholders and compromise between them	Choice aimed at satisfaction of stakeholders concerned
Design Process	From preliminary design to detailed design	From ideal constraints to alleviated constraints to achieve solution at all
Communication	Keep everyone involved informed on design status, approved changes and planning	Respond to information needs and demands of decision-makers
Persuasion of players	Make presentations to convince players who have to accept compromises	Persuade by supplying valid and relevant information
Progress Control	Divide process into small steps with identifiable milestones against deadlines	Pay attention to both “hard” and “soft” information on progress
Divisions of tasks	Define division of tasks and responsibilities in job and function descriptions	Think in roles rather than tasks, using broad job descriptions
Integration & Coordination of tasks	Integration & Coordination of tasks is a prime responsibility of the project manager	Create a climate for mutual adjustment of tasks
Standardization	Standardization where possible as it reduces complexity	Standardization only where functional and genuinely accepted by stakeholders

Figure 8: The PI and PII Management styles

The common management style that is implemented in the project management of civil engineering projects in Manado can be summarized as a strict PI approach. Some of the points are already been investigated in the Process management styles. This counts for the Goal setting, Leadership, Design Process and Persuasion of players which are pure examples of PI management.

The other aspects that are only used in Project Management have also the character of PI management. In imitation of the leadership aspect, the division of tasks and progress control are totally under control of the directors. They are the ones with all responsibilities and means to control this aspect. By power based on hierarchy the employees do exactly what they have been ordered to.

A slightly view on the organic chart tells that the project management in a company is top down. According to their influence there is the Manager, Project Manager, Site Manager, Supervisor, Finance, Administration. These workers are all working with a contract, while the inexperienced workers are paid on daily basis.

The best approach for the city of Manado is to make the right combination between PI and PII. The mindset of the people is very important when certain chooses have to be made. As stated in the process management style the people do not like when there is a high uncertainty about their responsibility and tasks. On the other hand are there al lot of environmental parties who wants to participate in the progress and goal setting.

3.5 Payments, Manpower and equipment

Companies also have to pay tax over their income. At the end of a project the amount is almost 30%. When a project has the government as its client, the budget in most of the times 110%. After construction the contractor gets 100% and the government keeps the other 10% as tax.

The corporations are rewarded by down payment. At the start of the project they get a down payment of 20% of the total costs. After reaching a progress of 30% the builder gets another 10% of the total costs. This 10% makes the down payment 30% of the total costs. As progress goes further the payment goes accordingly (60% ready= 60% percent of payment). Starting the project needs some additional financing. Through own funds or a collaboration with the bank this financing is established.

Employees can be found from every corner of the world. Local building sites show a diversity of people, with different origins but all Indonesian. Differences are found mainly found at the level of culture, although everyone comes from Indonesia. This is shown in the working philosophy of people. Within a project one tries to establish a mixture of different origin (both in culture as in number). E.g. workers from Manado are not strict at all, workers from Java are somewhat more strict.

At a building site one can find two type of workers. *Skilled workers*; these workers are contracted by the company. Have an insurance , are paid by bank and do have to pay tax for their earned money. The amount of tax is indexed by tables, with a minimum income of 53 million IDR a year. *Unskilled workers*; it is not surprisingly, but these workers haven no contract, are paid by cash, are also insured and do not need to pay tax for their earned money.

Equipment used during a project is, in many cases, owned by the contractor. Due to high rental costs, contractors who have no equipment at all, are more expensive. This is why these companies won't make it through the bidding phase. Within the bidding the equipment is included. Companies won't use a redemption to invest in new equipment in case of a malfunction.

4 Conclusion

Process management is in the construction industry the business which can be summarized as the philosophy of a goal seeker. During all phases of a project it has to deal with unknown or partly known goals and stakeholders. Decisions will be made on the basis of strategy, pros and cons are analysed and trade-offs will end up in a common goal that fits for almost everybody. The context of the process is interwoven and erratic, every stakeholders has his own interests and think strategically to ensure his personal goals will be reached.

A business case, which is very common in the Western world, is not implemented in here. A detailed master plan of the region and especially the city of Manado is missing. This results in a lack of project rationale, project scope definition and feasibility analysis. Every project, related to the vision and mission of Manado City is on its own. While the city of Manado is aware of the need to map the stakeholders and environmental impacts, but the implementation of a high quality analysis is not yet come to an execution.

To prevent the city of any form of corruption, a transparent communication in the process needs to be established. A new management approach is therefore necessary to implement the Eco Tourism image to the city of Manado. All stakeholders and environmental issues have to be taken into account when it comes to formulating of the scope. A clear hierarchical or network approach is not the answer to solve this problem in a city like Manado. A combination of both approaches is the best way to manage the city in order to achieve the main goal, an Eco Tourism City of Happiness. Both the approaches have their advantages, based on the habits of the people and diverted interests of the stakeholders.

Internal support for the vision and mission creates a positive charisma of the city to the outside world. Such a positive atmosphere will be picked up by other cities, in and outside Indonesia, so they can implement the “green” label in their own city. The strength of this marketing tool can be exploit during the implementation phase. When the world is aware of the high degree of development in the region of Manado a first signal is given to attract tourist and investors. A proper marketing department is needed to put Bunaken and Manado on the map, which starts by a lot of information distribution to the citizens of Manado.

The concept of involving people in the matters that affect them is a well-accepted principle of leadership and management. Involvement is a powerful value that affirms the unique contributions of the individual. It unlocks enormous potential through synergy and allows organizations to implement changes more effectively. So when possible solutions come to the table, to solve the unique problems inside the city, the use of local characteristics are needed. There is no need to re-invent the wheel but every solution needs to be investigated on the feasibility of the location by the use of their own strengths. Successes from other cities are no guarantee for a success in Manado.

When all necessary aspects of the business case is ready, the next phase appears. Project management, an unique and clearly delineated management discipline with clear goals and requirements. The total control of budget, time schedules, labor, organization, information flows and quality are the main tasks to make operational decisions. The actors and stakeholders are known in this “frozen” context.

A tender is written according to this clear scope and requirements by the project owner. The tender can be joined by all kind of companies, although there are certain demands. For the tender there is a minimum number of 3 competitors needed. Each competitor needs to have 4 years experience in the area in which the project will take place. A company can only attend the tender if they have developed a project in the past which had a minimum value of $^1/_3$ of the current projects budget, which is stated by the client. The classical contract form between Principal and Constructor.

The common management style that is implemented in the project management of civil engineering projects in Manado can be summarized as a strict PI approach, based on hierarchy. Because the fact that there is no need for consideration of environmental aspects, this form of management works very good. When there comes a switch to an EMVT, small adjustments need to be made to assure that the surroundings are managed.

5 Recommendations

After successful completion of the initial phase of the project, it is very important to keep the momentum going with plans for maintaining the project and identifying areas of improvement and steps to enhance the strength of the project through new plans, mitigate measures, proposals to stakeholders who show mild opposition, business cases for investors etc. The implementation of the vision and mission faces some difficulties, by taking account of these recommendations seriously, the process will improve, without expanding more money.

If you wait for the latest thing, you'll wait forever. This is true for all innovations. Don't be afraid to invest in a solution today because you're afraid something better will come next year. Guess what, there will be something better next year. But, the new solution will be superseded in a year, too. What comes out next does not make your investment today any less capable. You're need to solve the problem from now. Come what may, you can benefit years of use from it.

Make Manado a City of Happiness is a perfect mission to fulfill the needs of the inhabitants. To create happiness among the citizens, well known nuisances have be terminated. This includes the lack of recreational areas in the city centre and the filthiness of the streets and rivers.

The infrastructure of Manado City needs to be improved in terms of quantity and quality. Not only the roads has to be taken care of but especially the drinking water, electricity and internet. To be an economical city which prefer substantial growth, they must rely on good working internal transport, electricity facilities and fresh water supply.

The enforcement regarding the maintenance of all civil engineering constructions has to be executed. Specials plans need to be written to make sure that every road, bridge and … have a long lifetime experience. It is more eco friendly and financially beneficial to maintain the existing construction then to build new ones. Any reasons to construct instead of maintain is less valuable than the mentioned advantages.

The available knowledge is not applied in the construction industry. There is a lot of room to improve the current process but this will not be implemented. By drawing a beautiful picture about the situation, you block any development. It is time to show your weaknesses, so other parties can be useful to overcome serious shortcomings.

5.1 Ideas and advices

*Continuous use of **public media** to enlighten the citizens about the advantages of the collection of waste and garbage:*

- *This calls for an effective and creative PR team.*

Need for large capital:

- *Create a **business case/plan to be sent to private investors** highlighting the prospects of returns on investment to attract private investors.*

*Invite global companies that have interests in Manado to invest. For example companies like **Google (Google Maps), Vodafone, etc.** would like to participate for publicity and popularity.*

There need to be more consistence between the different governmental agencies. All these differences lead to the implementation of own rules and regulations.

Stimulate Research & Development. It is now 1,0% of the BPN and according to many research articles it has to be 3% or higher, in order to create new technology and products.

Appendix G
Coastal Protection

Contents

List of figures

1 Introduction

The shoreline of Manado City has developed itself in the past decades. At that period of time, Manado City had an uninterrupted shoreline with sandy beaches covering the shores. This changed when authorities first decided to make a boulevard road along the beach and subsequently decided to create new land in front of that boulevard road. Nowadays the shoreline of Manado consists of a lot of reclamation areas covering almost the entire shoreline.

Amongst others, the reclamation has had an influence on the equilibrium state of the shoreline, which led to coastal problems. **Error! Reference source not found.** visualises the erosion near Molas (the red dotted line approximately represents the original shoreline). Not only the reclamation could be held responsible of the problems the entire shoreline is suffering. Climate change, for instance, could also have an influence on that.

In the analysis, the problems that the different parts of the shoreline are suffering, were described and examined. Also a clear picture of the three different parts to be considered is represented in the analysis. In this report, recommendations will be given on the different parts of the coast. The recommendation will be depend on the outcome of the analysis made.

These recommendations will be considered mid-term solutions. The problems need to be solved, but it is unachievable to solve them in short term. However, one should not wait too long, because the problems are still evolving.

Figure 1: Eroded shoreline (Molas)

2 The need for protection/improvement

The three analysed parts do not all need protection. From the analysis it can be obtained that the southern part of the coastline is already taken care of. The southern shoreline suffers from erosion, due to heavy wave attack during storms. Roads along the shore are in danger because of the erosion. Yet, a project has already started to protect the southern shoreline. Again from the analysis, this protection seems to be durable and well designed. So this design can be recommended, as can be read in the 'recommendations'.

As well as the southern shoreline, the reclamation area does not need extra attention, regarding the protection of the reclaimed areas. In fact the coastal protection is a little bit over designed, as can be obtained from the analysis. There can be concluded that the protection doesn't need improvement.

Nevertheless, considering the whole land reclamation and the additional effects of it, there are some negative side effects. The reclaimed area cannot be changed anymore, but future land reclamations should take this negative effects into account. However, when one would measure the currents in the Manado bay, one could find a solution to change the currents again, This can be done by making a simulation of the coastal movements in the bay. This would benefit the 'Bunaken' and the shoreline of Molas, which are being affected by the currents. So an improvement of the design of the land reclamations could be recommended.

Figure 2: Erosion near Molas

Unlike the two parts of the shoreline, which are mentioned before, the northern part of the shoreline does need protection. The area north of the fishery port, near Molas, has eroded heavily and the village 'Batusaiki' partly disappeared because of this. The construction of this fishery port and land reclamation area probably contributed or even caused the erosion. The change in currents along the shoreline of Manado triggered the erosion and nowadays the erosion is still going on, which could be obtained from Figure 2. This means that something has to be done to stop the erosion and preventing a larger area from eroding.

The northern part of the shoreline, thus, needs the most attention. In the next few chapters, possible solutions will be proposed and consequently some recommendations. The focus, however, will lie on the northern part of the shoreline, first figuring out how to approach a solution for the eroded area.

3 Erosion Molas (Batusaiki)

As discussed before, the eroded area near Molas (Batusaiki) needs the most attention. Before proposing possible solutions, first the type of solution has to be chosen. There are two types of solutions to solve the problems, namely restoration and reduction.

3.1 Restoration or reduction

Restoration means restoring the coastline to its original position, the striped line in Figure 1. This means that a solution has to be found in which erosion has to be prevented plus the fact that the shoreline has to move seaward to its former position. For instance a protection has to be designed, located at the original shoreline and the land behind the protection has to be reclaimed. This would be an expensive solution, given the fact that quite a large area has to be filled with sand. Nevertheless, this could be a possibility if one really wants to re-establish the original coastline.

Reduction of the erosion just means preventing the eroded area from eroding any further. In this case no large areas have to be filled with sand and will lead to a reduction of costs in comparison with the 'restoration' solution. This 'cheaper' solution only prevents the area from continuously getting eroded and will retain the shoreline as it is now. The village Batusaiki will remain the same and will not be restored, when choosing this type of solution.

So one should decide what the most important aspects are. For instance one could assess aspects like the necessity, the costs or universality of the solution. The costs of both solutions are discussed before; restoration means an expensive solution and reduction will lead to more reasonable costs.

Considering the universality of both types of solutions, reduction of the erosion is best applicable to similar erosion problems. A universal solution is applicable almost everywhere and one should strive to this kind of solution, because it will save a lot of effort and money if one just can apply the universal solution. When one chooses the 'restoration solution', first an investigation has to be done into, for instance, costs and feasibility. This already reflects that the restoration solution isn't entirely universal.

The most important question, probably, is the necessity of restoring the original coastline or just reduce the erosion. Considering the fact that the village is already, partly, gone and that people living elsewhere, there's no real need to restore the coastline. Local people will have to pay (a lot of) money to build new houses and Manado City also has to pay (a lot) more money to restore the coastline.

In that way, when there's no real need to restore the land and this also saves money, the best solution is to reduce the erosion and retain the shoreline as it is now.

4 Possible solutions

From the decision to design a solution which reduces the erosion and retain the coastline as it is nowadays, possible solutions will be presented. These solution will be discussed and the feasibility, applicability and whether the solution is a realistic option will be elaborated.

In the following section, possible solutions and combinations of solutions will be presented. Predominantly solutions will be proposed which reduce the erosion problem. Nonetheless, despite the conclusion of giving solutions which reduce the erosion, a solution of rehabilitating mangroves will be presented too. Even though it is a (partly) restoration solution. Fortunately, mangroves do have a lot of advantages, which could be very beneficial.

Among 'soft' protections, like mangroves, also solutions with sand supply or the use of degradable sandbags will be elaborated. These 'soft' protections mostly need frequently monitoring and are quite vulnerable, but nonetheless they're really eco-friendly. 'Hard' protections are more solid, but usually are less ecological. In this case, 'hard' protections like breakwaters and submerged dams will be discussed, as they seem to be a reasonable solution. However, this will be investigated in the following section.

4.1 Mangroves

Rehabilitation mangroves is not an easy job. One has to take into account several aspects, amongst others tidal frequency, the disposal of sediment and the sufficient time for seeds to settle. Therefore the hydrological conditions need to be supportive to give the mangroves a chance to grow back.

As mentioned before, different kind of mangroves need a different kind of tidal frequency. To meet this necessity, the mangrove species that already grow in the surrounding area should be used. This is applicable, because of the fact that the tide did not change, only the current pattern. The use of different species could for instance drown the mangroves. So, correspondingly, the depth and slope of the coast are an important factor. Mangroves also need sediment and water calm enough to provide the seeds sufficient time to settle. Along the shore of Molas, all the sediment is flushed away and therefore an additional solution has to be found to supply sediment, but also to protect the sediment from flushing away again.

Figure 3: Rhizophora

To rehabilitate the mangroves, one not only has to meet the hydrological conditions, but also the environmental/ecological conditions. For instance, mangroves should not be planted to dense and during the growing process, nursing decreases the mortality rate. Tides are also of an ecological importance, the growing process of the mangroves will be improved. Another thing to improve the rehabilitation of mangroves is to use fast growing Rhizophora. In that way, the mangroves will be matured sooner and therefore be stronger.

So the mangroves will be able to hold the sediment and this will improve the overall growing process. An additional advantage is that this species is growing near Molas, so it meets the hydrological conditions.

From the previous lines, it will be clear that a solution with only mangroves will not last. The next section, therefore, will provide combinations of solutions. These combinations, which will be presented next, will be further elaborated in the following sections as a stand-alone solution.

Only Mangroves

Mangroves are good coastal protections and do have an environmental value as well. To use only mangroves, therefore, will increase the ecosystem services. Ecosystem services have several functions like regulating, provisioning, cultural and supporting. So, besides protecting the coast (regulating), mangroves can also provide woods (provision), they have a recreational function and therefore it improves tourism (cultural), and finally they nurse habitats (supporting).

Figure 4: Mangrove shoreline

Therefore, the best way to protect the coast is to use mangroves (only). This is a good example of ''using your own opportunities and improve them''. However, before one can rehabilitate the mangroves, the hydrological conditions have to be met again. This means that sediment has to be supplied to re-establish the depth and slope. A sediment supply will not cause any problems, the only question is how to retain the sand. A current now erodes the shoreline and will probably also erode the new supplied sand. An additional uncertainty is the ability of seeds to settle, knowing there is a current present, which do not give seeds sufficient time. In this case, monitoring and maintenance is very important to guarantee the growth of the mangroves.

This will lead to additional solutions, which will be elaborated next.

Submerged dam

To trap the sediment, supplied along the coast, and to keep the water still enough to let the seeds settle and grow, construction of a submerged dam is an option. The mangroves can only grow back if the natural slope is restored again and with a sediment supplement this can be achieved. To keep the sediment from getting eroded again, a dam has to be constructed to prevent this. The dam should be high enough to prevent the current flushing the sediment. However, it also should be low enough to allow the tides entering the mangrove area.

The dam can be constructed with different kind of materials. To keep the costs low and take into account the environment, one can choose to use sandbags. The bags can be made of degradable material, so when the mangroves are fully grown, the bags are decayed. These sandbags, however, are not as solid as rubble mound dams. Rubble mound dams are more robust and more expensive, but this also is an alternative. In fact, a rubble mound submerged dam probably would be more stable because of the large stones and heavy weight. Another possibility is to make use of local resources, but the sandbags and rubble mound dams are the most assumable solutions.

Emerged dam

Instead of using a submergible dam, an emerged dam is an interesting solution as well. The dam, in this case, raises above the water level. The advantage is that no waves can penetrate, but more important, it will prevent the current from entering the mangrove area. In this way, the sediment will remain in the area of the mangroves and seeds can settle. The only disadvantage is the fact that tides cannot enter the mangrove area, because of the blockage of the dam.

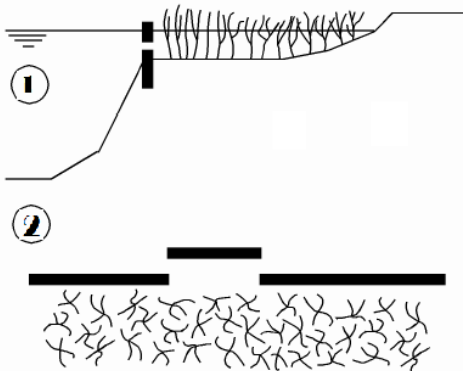


Figure 5: Breaches in emerged dam

To solve this problem, the construction of breaches in the emerged dam is a resolution to let the tides enter. In Figure 5 two possibilities of making a breach in the dam are visualised. The first possibility is a cross section, with breaches through the dam, for instance holes. In this case, an option is to use wooden sheet piles, because it is impossible to create holes in rubble mound dams. The second possibility (top view) actually are three separate dams, which prevent penetration of waves and currents, but let tides enter the mangrove area. This option can be can be executed as a rubble mound dam and is also the most plausible way to execute this dam.

Breakwater

Unlike the previous two additional solutions, which prevent the current from entering the mangrove area, an alternative which diverts the current is also an interesting alternative. If the breakwater can divert the current, the erosion would be reduced and sediment will remain in the mangrove area so mangroves will be able to grow. However, just like the previous solutions, sediment has to be supplied first. Also, an additional construction might be needed if seeds do not get sufficient time to settle and grow.

The breakwater will most probably be executed as a rubble mound breakwater. In the next section, the construction and design of a breakwater will be discussed in more detail. In combination with mangroves, this solution would probably be the most expensive.

Figure 6: Construction of a rubble mound breakwater

4.2 Breakwater

A breakwater can reduce the erosion along the shoreline of Molas, by diverting the current. The construction of the fishery port or probably the overall land reclamation changed the current pattern. A plausible assumption is that after construction of the port, a eddy pattern behind it developed. From the analysis it has made clear that channels occurred at the north side of the area and evolved southwards, which would suggest the presence of a eddy. Therefore, a breakwater has to be designed to change this eddy current behind the port. A point of interest with this design is that the current should be redirected in such a way that it doesn't starts to eroded the shoreline further north.

Figure 7: Eddy current pattern

Shape

Before the type of execution will be decided, first the shape and location has to be determined. Figure 7 visualises the present situation, including the plausible current pattern. The breakwater should be long enough and extending far enough to the sea to actually divert the current. However, there are several issues involved, like costs, effectiveness and depth. The surrounding depths of the existing breakwater of the port, located most seawards, are approaching the 20m. That means that the new breakwater cannot be extended to much seawards. Otherwise the breakwater would be too expensive. The shape of the breakwater has to bed like depicted in Figure 8. In this way, it will lead the current away from the bay. Though, there still need to be an investigation into the effectiveness of this design and also the cost-effective shape and length of the breakwater should be investigated first.

Figure 8: Breakwater + redirected current

Execution

There are several methods to construct a breakwater, sea-based or land-based, but there are also multiple ways to construct a breakwater. Both a land-based as a sea-based execution are possible. Regarding the infrastructure, a land-based execution would be recommended, because the quarries lie close by. In that way, stones and rubble can be transported directly to the construction site instead of first being overloaded.

Considering the executing of the breakwater, the best way is to construct a rubble mound breakwater. Regarding the local availability of materials, this would be recommended. However, the harbour in Manado City is currently under construction and they are constructing a breakwater with a concrete armour layer (comparable to x-blocks). The use of monolithic breakwater would, nonetheless, be too expensive. A consideration between a Dutch style breakwater (X-block armour layer) and an Indonesian style breakwater (using local available rubble) have to be made. One has to keep in mind, that the function of the breakwater is divert the current and not to breaking waves. However, an x-block armoured breakwater can be applied, but it should be executed not that heavy.

Nevertheless, it is not realistic to construct a breakwater with an x-block armour layer. It is too expensive and secondly, it would still be too heavy for only diverting the currents. Therefore, the best option is to construct a rubble mound breakwater with locally available material. In Figure 9 the quarries are depicted as yellow circles and the construction site as red circle.

Figure 9: Quarries

4.2.1 Stability

To guarantee the stability of the breakwater, the filter structure must be calculated. In the appendix ''coastal protection: filter layers'' the filter structure is calculated and nothing about the possible core material is presented. The filter structure is build up like presented below:

- Original seabed: d_{50} = 400µm;
- Intermediate layer: d_{50} = 10mm;
- CP45/125 (core);
- CP90/250;
- Armour layer: HMA 300 – 1000.

An illustrative design is presented in Figure 10. The core consists of the CP45/125 sand. To guarantee the stability of the breakwater, the intermediate layer is used as a filter bed and not as core material. The height of the breakwater depends on the bottom elevation, which isn't defined precisely. Using available maps and data, a rough estimation is made, which results in a breakwater height of 10m. The thickness of the layers, taking into account the feasibility, are respectively 88cm for the armour layer and 30cm for the CP90/250, CP45/125 and intermediate layer. A toe construction can also be applied, in which there are two possibilities. One possibility is to execute the toe with the same material as the armour layer, but another possibility is to execute the toe less heavy.

A common solution is to use a stone class which is less heavy, for instance this would be LMA 60 – 300 in this case. The width of the crest is designed to be 8m, in this way two vehicles can pass each other all the time. On the other side, it may be more cost-effective to construct the breakwater with a width of about 5m. In case of a small availability of trucks, this would be the best option. This means that a land based construction is considered, which indeed is the best option, regarding the fact that the quarries are close by. Examining the existing breakwater of the port, a slope of approximately 1:1 à 1:1.5 is used. So to make a slope with the same inclination would be logical.

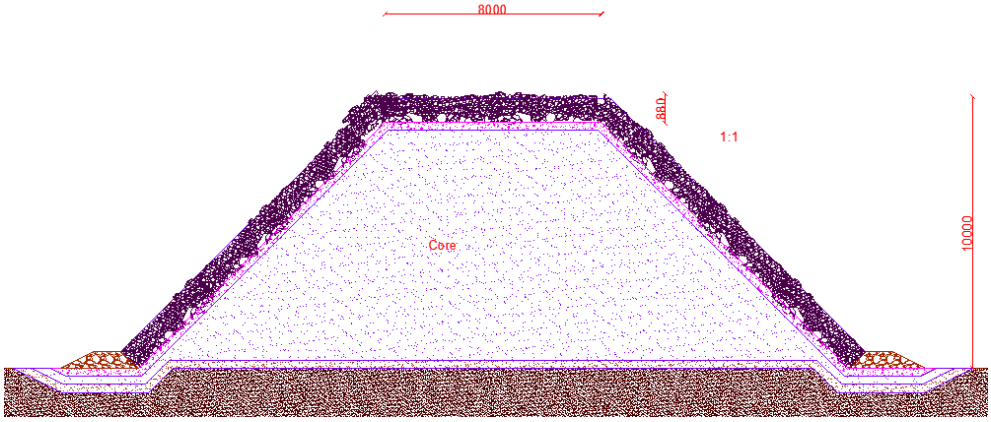


Figure 10: Breakwater design 1

Figure 10 illustrates a proposal for constructing the breakwater. Although, an Indonesian style of constructing a breakwater, which is applied on the existing breakwater, can also be consistent. A third option for the design is depicted in Figure 11. The advantage of this design is that it is executed less heavy, which saves material and thus will reduce the costs. This design is well applicable, because the inner side is located in a bay, which means that there's no wave attack and no current influences.

However, constructing a breakwater with an rubble mound armour layer, provides habitat for fish, sea animals and plants. So from an ecological point of view, it would be better to construct a breakwater with an armour layer which covers the entire body.

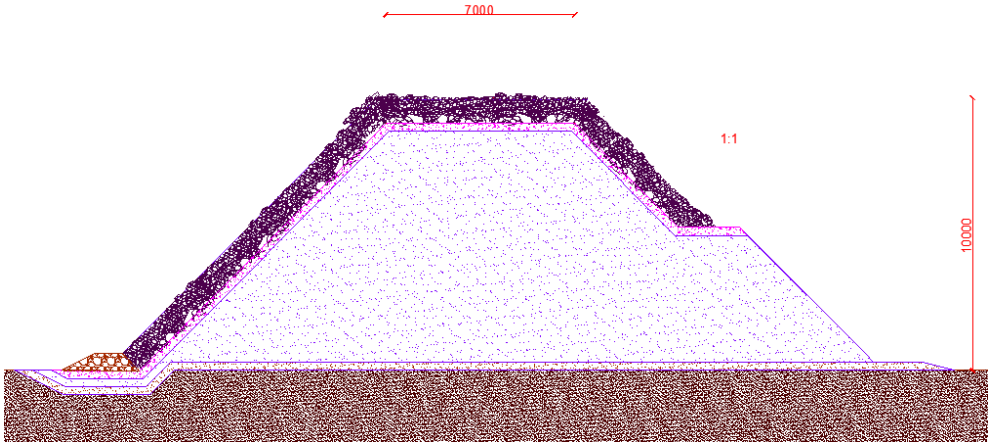


Figure 11: Breakwater design 2

4.3 Coastal protection

Instead of rehabilitating the mangroves or trying to divert the current pattern, a third option to reduce the erosion is to protect the shoreline as it is now. There are several methods to construct a coastal protection. In the most simplest case, a protection with sandbags or geotextile can be used. A very rough way to protect the coast would be constructing a vertical wall and the most plausible option is to make use of rubble. In the following subsections, these options will be further elaborated.

A possible fall-back applying this kind of solution is that it only shifts the problem. In that way it would only protect the eroded area and will start to erode the area northwards. However, northwards of the eroded area, a mangrove forest is located. This will minimise the probability that the coastal protection actually shifts the erosion. Besides, the mangroves have not disappeared since the current pattern changed, so after the construction of the coastal protection they probably will not either.

Sandbags

As stated before, sandbags are the most simple and cheapest solution to protect the coast. However, making use of sandbags is not a very solid solution. A sandbag could consist of degradable or non-degradable material. In this case it is better to use non-degradable material, because the bags have to protect the coast for a long time and must be durable. Even though if the sandbags will survive, for instance 50 years, the effectiveness of the bags have to be researched. Also construction of sandbags with non-degradable material could be affecting the environment, in case they're suffering from wear and tear.

The previous would suggest that an additional construction is needed to guarantee the stability of the sandbags. Also from an ecological point of view sandbags are not the perfect solution. For instance, a beach nourishment added to the sandbags would give an eco-friendly solution. A disadvantage of this solution is that a frequent nourishment is needed to prevent that the sandbags will be exposed. Another way to guarantee the stability is to connect the sandbags, so they are not able to wash away separately. Nonetheless, Figure 12 visualises an effective sandbag protection without any additional measure.

Figure 12: Sandbag protection

Vertical wall

To protect the shoreline, the construction of a vertical wall is possibility too. This is a very rigid construction, compared to the sandbags. Besides, it actually is a very effective solution. A vertical wall will be constructed a few feet landwards and retains all the soil behind the construction. The erosion will continue until it reaches the vertical wall. Because of this, the vertical wall should be designed in such a way, that it will remain stable. Even if the erosion has reached the wall. A rule of thumb is that the part above the soil is 1/3 and the part driven into the soil is 2/3 to keep the vertical wall stable. In normal situations, scour in front of a vertical wall can be expected. However, in this area tides dominate and wave attack is very marginal. That means that scour do not need to be taken into account.

For the execution of a vertical wall, a few possibilities are suitable, for instance sheet piles, diaphragm walls or soil mixtures. Sheet piles can be driven in almost everywhere, as long as the soil is soft enough to drive the sheet pile. This is an advantage, comparing sheet piles with diaphragm walls and soil mixtures, because the sheet piles can be placed on the erosion line. Besides sheet piles, also combi-walls can be used, but the principle is the same and combi-walls actually are too heavy to solve the erosion problem near Molas.

Diaphragm walls and soil mixture cannot be executed in the water. These types of vertical walls need resisting soil pressure to construct such a structure. First soil has to be excavated, regarding diaphragm walls, reinforcement has to be place into the excavation and finally the excavation can be filled with concrete. The soil needs to produce a resisting pressure, so the concrete can harden. Soil mixtures are similar to bored piles. To construct a soil mixture, first a hole will be bored. That hole will be filled by some kind of mixture, like bentonite, and this mixture needs time to harden out.

Figure 13 visualises the vertical wall principle as described.

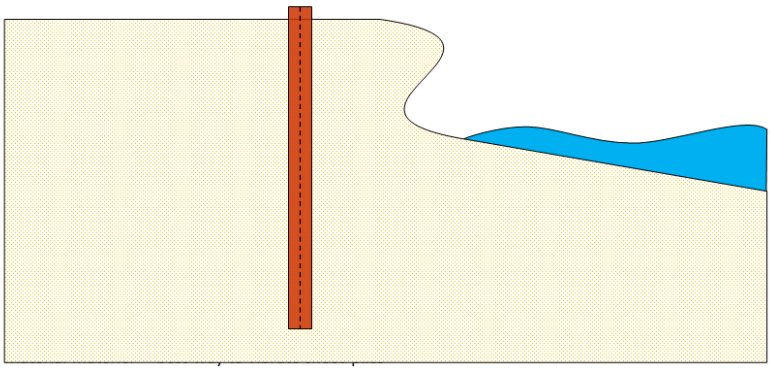


Figure 13: Vertical wall principle

The best method to drive sheet piles into the ground is by vibration. Therefore, a vibration block has to transported to the construction site. Besides, the steel sheet piles need to be transported to the site too, so this should not be a setback. Also constructing diaphragm walls and soil mixtures, equipment and material needs to be transported to the site, so there is no difference comparing to sheet piles.

Rubble mound

Instead of creating a vertical wall or using sandbags, another option is a coastal protection of rubble. The advantage of using rubble is that it is locally available. In the breakwaters section the location of the quarries are depicted. However, the size of the rubble has to be smaller than the rubble used for construction of the breakwater. The only function should be, protecting the shoreline from the eroding current. Figure 14 represents a rubble mount shore protection.

Figure 14: Rubble mound protection

From an ecological point of view, rubble is also a good method to construct the protection. Rubble is a natural product and creates habitats for fish and sea plants. Figure 15 visualises this.

Rubble cannot be 'just' dumped along the eroded shoreline. If the difference in sizes between the rubble and sand are too large, the sand will still erode. To prevent this, a filter bed has to be designed of another possibility is to make use of geotextile.

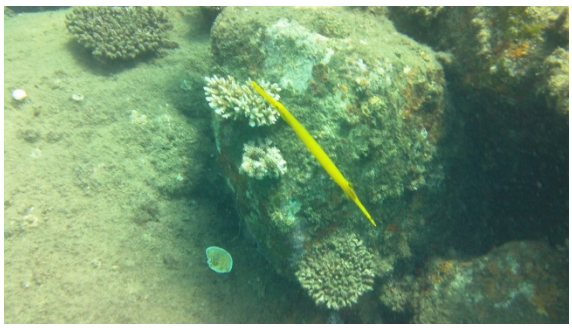


Figure 15: Habitat on rubble

Geotechnical analysis represents the sediment properties of mud, located along the eroded shoreline. The d_{50} is approximately 0.2mm.

As mentioned in the breakwater section, the calculation of the filter layers can be obtained from the appendix. The filter structure is:

- Original beach soil: d_{50} = 200µm;
- Intermediate layer: d_{50} = 10mm;
- CP45/125;
- LMA (armour layer).

So with an layer thickness of 20cm for the sand layers and about 50cm for the light rock, a total coastal protection of 90cm should prevent the erosion. Figure 16 represents an illustrative design of the coastal protection. In this design, a toe is included, but this could easily consist of the same material as the armour layer.

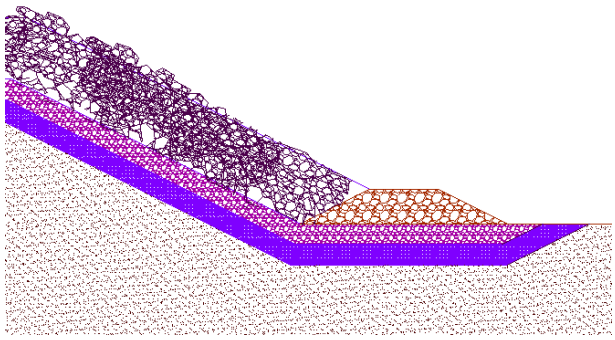


Figure 16: Schematised design

4.4 Multi Criteria Analysis

All possible solutions are considered, but it is not entirely clear what the positive and negative points are of each design. Therefore, a multi criteria analysis is made. In Figure 17 this multi criteria analysis is represented. Different values are given, depending on whether it is (very) positive, (very) negative or neutral. Each aspect is given a different factor value too. In this analysis, the effectiveness is considered as the most important aspect, also the ecological value of the design has a high rating. The latter is because there are a lot of mangroves and coral reefs in the surrounding area and the design has to be suitable for the environment. Aspects like experience and feasibility are considered less important in comparison with the other aspects.

		Feasibility		Ecological		Effectiveness		Costs		Availability of material		Experience		Total value
Mangroves		(factor value: 5)		(factor value: 8)		(factor value: 10)		(factor value: 7)		(factor value: 6)		(factor value: 4)		
	Only mangroves	5	25	5	40	1	10	5	35	5	30	1	4	144
	Submerged dam	3	15	5	40	4	40	4	28	4	24	2	8	155
	Emerged dam	3	15	4	32	4	40	3	21	4	24	3	12	144
	Breakwater	4	20	4	32	4	40	2	14	4	24	4	16	146
Breakwater														
	Design 1	4	20	4	32	4	40	2	14	4	24	4	16	146
	Design 2	4	20	3	24	4	40	3	21	4	24	3	12	141
Coastal protection														
	Sandbags	5	25	3	24	2	20	5	35	5	30	3	12	146
	Vertical wall	2	10	2	16	3	30	2	14	2	12	1	4	86
	Rubble mound	4	20	4	32	3	30	4	28	4	24	4	16	150
Explanation: 5 very positive, 4 positive, 3 neutral, 2 negative, 1 very negative														

Figure 17: Table MCA

From the multi criteria analyses it can be obtained that the total value of each solution is quite similar. The only solution that has a different value is the vertical wall protection, it is much lower than the rest. So, except for the vertical wall, any solution can be selected. The best solution, according to the analysis, is the submerged dam in combination with mangroves. Although this strongly depends on the mortality rate of the growing mangroves. In fact, all the solutions with mangroves are affected by this mortality rate. The second best solution, obtaining from the analysis, is the rubble mound coastal protection. This is a quite solid solution, however the effects should be investigated first to be absolutely certain.

Additional, the effect of sensitivity of the different aspects is considered. It can be stated that the increase in factor value of the feasibility and costs were the only ones that have significant effect. Increasing the feasibility factor value leads to negative advise upon the execution of the emerged dam. On the other hand the solution regarding only mangroves will gain the top of the chart position and would in this case be best applicable. The increase of the cost factor value leads to a negative recommendation regarding the breakwater solutions.

The multi criteria analysis contributes in determining the best suited solution, however from Figure 17 it can be obtained that the results are quite the same. So in the next chapter, recommendations will be given about the possible solutions.

5 Recommendations

The shoreline of Manado has changed the last few decades and experiences several problems, for instance it suffers from erosion. In the analysis the shoreline has being analysed and divided in three parts, namely the southern part, the reclamation area and the northern part near Molas. In this report the need for solutions was presented and possible solutions were elaborated, where required. The next section will propose some recommendations upon the problems of the different parts.

The southern part of the shoreline has been suffering from erosion due to heavy wave attack. Currently, this stretch of coastline is under construction and being improved by means of a coastal protection. A battered wall with on top a crown structure, to prevent overtopping, is designed and from the analysis it can be obtained that this is solid and durable design. So, from this, this design can only be recommended to apply at similar locations. Areas who have been suffering from heavy wave attack can easily apply this design, because it can offer a very good coastal protection. Another positive aspect of this design is the application of local available material. This means that the design can be applied almost everywhere in Indonesia, provided that the same wave conditions are present.

The coastal protection of the reclaimed area does not need any improvement, it actually is a little bit over dimensioned. However, the land reclamation areas as such do need some attention. Construction of the reclamation resulted in a changed current pattern along the shore of Manado. As stated in the analysis, this is causing sediment flowing towards ''Bunaken'' and killing the fish and coral reef. Another effect of the change in current pattern is the erosion along the coast of Molas. This is never desired, so it is recommended to investigate the current pattern and to discover what the explanation is of this change. Once the source is known, something can be done to divert the current and prevent the erosion near Molas and the ''Bunaken'' from disappearing.

An additional recommendation is to investigate the current pattern change before a new area will be reclaimed. So if there are plans to reclaim new land in the future, one should first do a research into the possible consequences. In this way, negative effects on coral reef and sandy beaches will be prevented as much as possible. Considering the future of Manado and the ''Bunaken'', this recommendation should not be neglected.

The northern part of the shoreline also suffers from erosion, but it has a different source regarding the southern shoreline. Due to the construction of the fishery port and reclamation area, the current pattern changed in such a way that an eddy originated, down drift of the fishery port, which is causing the erosion. Some recommendations to divert the overall current pattern are already given, but to solve the local problems near Molas, several possible solutions will be recommended. The multi criteria analysis provides useful information upon which solution is most suitable. Frankly, it only entails the fact that a vertical wall is less suitable comparing to the other solutions. The other solutions are equally suitable.

A solution with mangroves can be recommended, because mangroves have a high ecological value and from an environmental point of view they are the best solution. Mangroves are a natural coastal protection, which prevents the shoreline from eroding any further. Actually, rehabilitating mangroves is restoration solution that causes a progression of the shoreline. However, there are some risks applying mangroves.

The growth of the mangroves depends on the mortality rate of the seeds, so when a lot of seeds do not develop into fully grown mangroves, this solution is not very effective. Nevertheless, when planting the seeds in the right way, the seeds can develop into a strong mangrove forest. There are, nonetheless, additional constructions needed to guarantee the growth of the mangroves. A submerged dam, emerged dam or breakwater could be constructed to ensure this, in which all of this additional construction have their own positive and negative effects. Though, they are all more or less equally suitable. Additional, when a solution which contains mangroves will be chosen, the city of Manado really makes use of their own opportunities and are improving them.

Constructing a breakwater diverts the current in such a way that it cannot reach the shoreline anymore. The solution which contains the breakwater can be recommended, simply because it solves the problem and also is sustainable and solid. However, first an investigation into the effectiveness of the breakwater should be done. A small disadvantage is the costs of constructing a breakwater, but on the other hand it is a very sustainable solution. A regular breakwater and a reduced breakwater are valued approximately equally, so can both be recommended. The first design of the breakwater creates more habitat for flora and fauna and the second design reduces the amount of material.

A coastal protection along the shoreline would certainly reduce or maybe stop the erosion. A possible risk is that this protection could shift the erosion problem northwards. Although a fully grown mangrove forest is located northwards of this area, and probably experiences the current too, it is still intact. This would suggest that a coastal protection does not influence the mangroves. The coastal protection can therefore be recommended as well, also because it is not very expensive. Rubble can create habitat for flora and fauna and is a solid solution. Sandbags are very cheap, but are proven not to be very durable. Nonetheless, with regular inspection or maintenance this can be rectified. Both alternatives, therefore, are well recommended.

Regarding all the possible solutions, a cost-effectiveness investigation is recommended to determine the most suitable design. Also an overall recommendation is to improve the opportunities one has and to actually use them.

Appendix 1: Filter layers

Coastal protection

To determine the filter layers of the coastal protection, the current soil layer will be used as a base layer and from this layer, upper layers will be calculated till the armour layer is known. To calculate the filter layers of the coastal protection, the standard classes of rock grading will be used, which is visualised in Figure 18.

Standard classes of rock grading (EN 13383)

Class name	described in EN13383		D_{50} (cm)	D_{85}/D_{15}	D_{n50} (cm)	Layer thickness 1.5 D_{n50} (cm)	Minimal dumping quantity with layer of 1.5 D_{n50} (kg/m^2)
	range	range of M_{50} for category "A" (kg)					
CP45/125	45/125 mm	0.4-1.2	6.3-9.0	2.8	6.4	20	300
CP63/180	63/180 mm	1.2-3.1	9.0-12.5	2.8	9	20	300
CP90/250	90/250 mm	3.1-9.3	12.5-18	2.8	12.8	20	300
CP45/180	45/200 mm	0.4-1.2	6.3-9.0	4.0	6.4	20	300
CP90/180	90/180 mm	2.1-2.8	11-12	2.0	9.7	20	300
LMA 5-40	5-40 kg	10-20	18-23	1.7	17	25	500
LMA 10-60	10-60 kg	20-35	23-28	1.5	21	32	550
LMA 40-200	40-200 kg	80-120	37-42	1.5	34	52	850
LMA 60-300	60-300 kg	120-190	42-49	1.5	38	57	950
LMA 15-300	15-300 kg	45-135	30-44	2.7	31	46	700
HMA 300-1000	300-1000 kg	450-690	65-75	1.4	59	88	1325
HMA 1000-3000	1-3 ton	1700-2100	103-110	1.4	90	135	2050
HMA 3000-6000	3-6 ton	4200-4800	138-144	1.2	118	177	2700
HMA 6000-10000	6-10 ton	7500-8500	167-174	1.2	144	216	3250

Figure 18: Rock classes

Calculating the filter layers, first the type of filter has to be determined. Two options are available, namely geometrically open filters or geometrically closed filter layers. The risk of geometrically open filters is that sediment can flow out, though it is 'controlled'. With a strong current along the shore, there is a risk of failing. A geometrically open filter can definitely not be applied though, because the lack of data. For instance, the shear velocity is unknown.

Now the filter rules for closed filters can be applied. The closed filter rules are: Stability: $\frac{d_{15F}}{d_{85B}} < 5$, Int. Stability: $\frac{d_{60}}{d_{10}} < 10$, Permeability: $\frac{d_{15F}}{d_{15B}} > 5$. For the determination of a base layer when the filter layer is already known the stability and permeability rules can be written as: $\frac{d_{15F}}{5} < d_{85B}$(stability) and $\frac{d_{15F}}{5} > d_{15B}$(permeability). Vice versa, when the base layer is already known, the stability and permeability rules can be written as: $d_{15F}<5*d_{85B}$ (stability) and $d_{15F}>5*d_{15B}$(permeability).

The original seabed layer consists of 200µm (d_{50}) sand/mud, which can be obtained from the geotechnical analysis. The properties of this sand/mud are: d_{85}=0.8mm, d_{60}=0.29mm, d_{15}=0.05mm, d_{10}=0.04mm. That means one can chose for 2 layers between the seabed and the CP45/125 layer, to work towards a standard rock class. However, a choice is made to apply one layer with a wider gradation. The specifications of this ''sand'' are d_{15}=2mm, d_{85}=25mm and d_{50}=10mm. So applying the filter rules, the sand fits for both the seabed layer as the CP45/145 layer. This material can be contained from the quarry and will also be used as core material.

Applying the filter rules to check the wide gradation sand:

- The intermediate layer as filter layer:
  - $\frac{d_{15F}}{5} < d_{85B}$ → 1/5 * 25mm < d_{85B} ➔ d_{85B} > 5mm
  - $\frac{d_{15F}}{5} > d_{15B}$ → 1/5 * 25mm > d_{15B} ➔ d_{15B} < 5mm
  - $\frac{d_{60}}{d_{10}} < 10$ → $\frac{15}{1.8} < 10$

- CP45/125 as filter layer:
  - $\frac{d_{15F}}{5} < d_{85B}$ → 1/5 * 50mm < d_{85B} ➔ d_{85B} > 10mm
  - $\frac{d_{15F}}{5} > d_{15B}$ → 1/5 * 50mm > d_{15B} ➔ d_{15B} < 10mm
  - $\frac{d_{60}}{d_{10}} < 10$ → $\frac{85}{45} < 10$

This means that the chosen sand can be applied between the seabed and CP45/125. For obtaining the properties of CP45/125 Figure 19 is used.

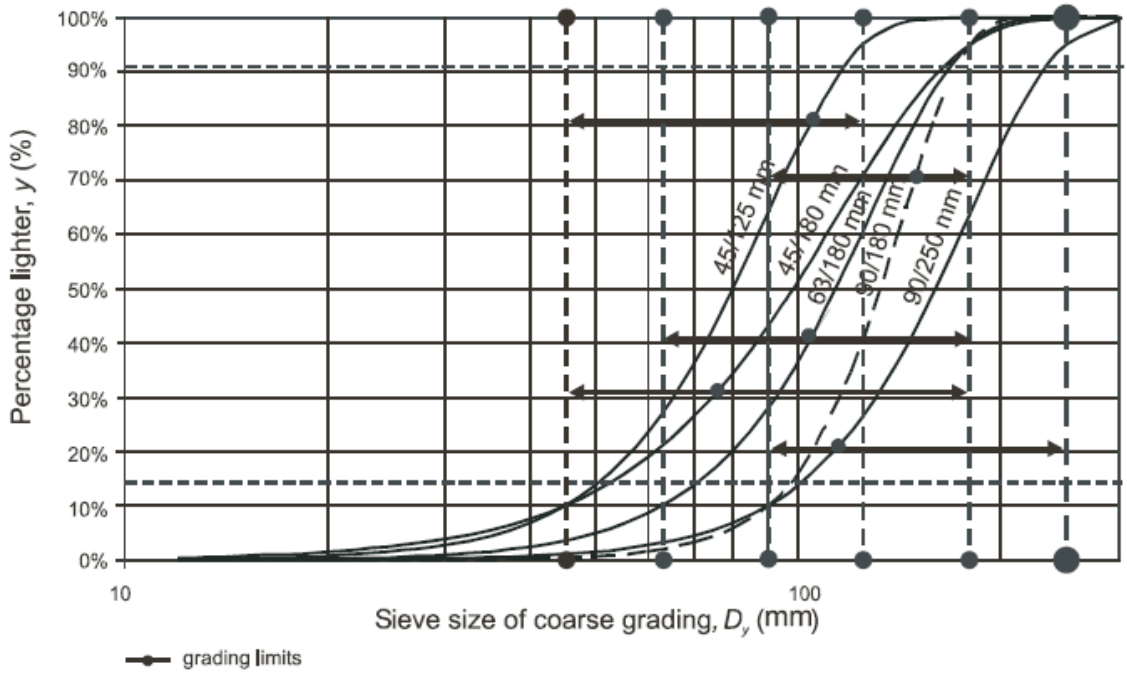


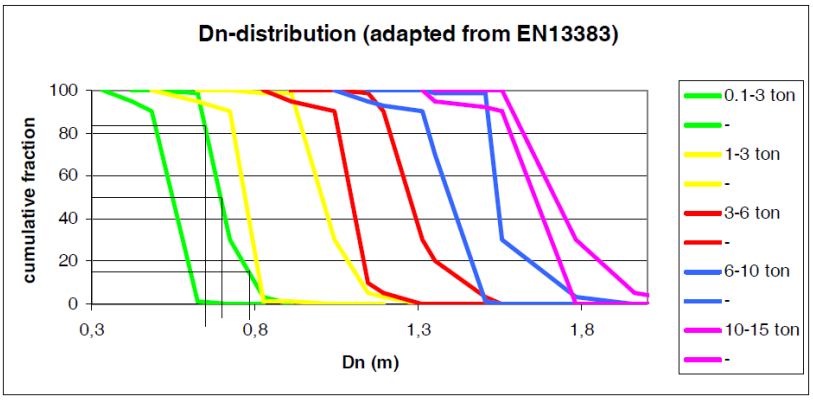
Figure 19: Sieve size of coarse grading

From the CP45/125 layer, the possible armour layer can be calculated. So applying the closed filter rules again: d_{15F} > 250mm and d_{15F} < 550mm. From this a light grading class fulfils the requirements of the filter rules, the heavy grading class would be over dimensioned. For instance, LMA 60 – 300 is well applicable.

Breakwater

The calculations of the filter layers of a breakwater will be similar to the coastal protection calculations, though the armour layer will be determined first. In this case, the geometric filter rules will be applied, because of the same reasons mentioned in the coastal protection section. In this appendix, only the filter layers will be calculated. The determination of what the core will consist of, will not be elaborated.

The armour layer can be determined quite well, regarding the nearby breakwater of the fishery port. The breakwater of the fishery port, concerning the armour layer, consist roughly of stones between 100 – 1000 kg (50-100cm). So a stone class of HMA 300 – 1000 would therefore be sufficient, concerning the similar hydrological conditions. From this the layer underneath this and whole filter layer can be determined. From the Dn-distribution in Figure 20 the D_{50}=700mm, D_{15}=650mm and D_{85}=780mm can be obtained.



Data from CUR 197 "Breuksteen in de praktijk", classes according to NEN-EN-13383 (2002)

Figure 20: Dn-distribution

So for the first base layer (layer under armour layer): $d_{85B} > \frac{d_{15F}}{5}$=130mm and $d_{15B} < \frac{d_{15F}}{5}$=130mm. To find a suitable stone class the sieve size graph of Figure 19 is used. **CP90/250** fulfils the requirements of the closed filter rules. Even $\frac{d_{60}}{d_{10}} < 10$ is true, because $\frac{170}{90} < 10$.

From this layer, the next base layer can be determined. The CP90-250 material gives D_{15} = 105mm and D_{85} = 220mm. Applying the closed filter rules, it is obtained that: $d_{85B} > \frac{d_{15F}}{5}$=21mm and $d_{15B} < \frac{d_{15F}}{5}$=21mm. The most suitable sieve size here **is CP45/125**, because also $\frac{d_{60}(85)}{d_{10}(45)} < 10$ is true.

To determine the next layer, which isn't a standard rock class, it is wise to examine the seabed soil first. The soil properties are: d_{10} = 0.09mm, d_{15} = 0.1mm, d_{50} = 0.4mm, d_{60} = 0.6mm, d_{85} = 1.65mm. So applying the closed filter again:

- The seabed as base layer:
  - $d_{15F} < 5 * d_{85B}$ → 5 * 1.65mm > d_{15F} ➔ d_{15F} < 8.25 mm
  - $d_{15F} > 5 * d_{15B}$ → 5 * 0.1mm > d_{15F} ➔ d_{15F} >0.5 mm
  - $\frac{d_{60}}{d_{10}} < 10$ → $\frac{15}{1.8} < 10$

- CP45/125 as filter layer:
  - $\frac{d_{15F}}{5} < d_{85B}$ → 1/5 * 50mm < d_{85B} ➔ d_{85B} > 10mm
  - $\frac{d_{15F}}{5} > d_{15B}$ → 1/5 * 50mm > d_{15B} ➔ d_{15B} < 10mm
  - $\frac{d_{60}}{d_{10}} < 10$ → $\frac{85}{45} < 10$

This means that d_{15} of the intermediate layer has to be smaller than 8.25mm, but larger than 0.5mm. The d_{85} needs to be larger than 10mm. So the intermediate layer can have the same properties as the intermediate layer of the coastal protection, namely: d_{10} = 1.8mm, d_{15} = 2mm, d_{50} = 10mm, d_{60} = 15mm and d_{85} = 25mm.

Figure 21 represents the sieve curve of the seabed material.

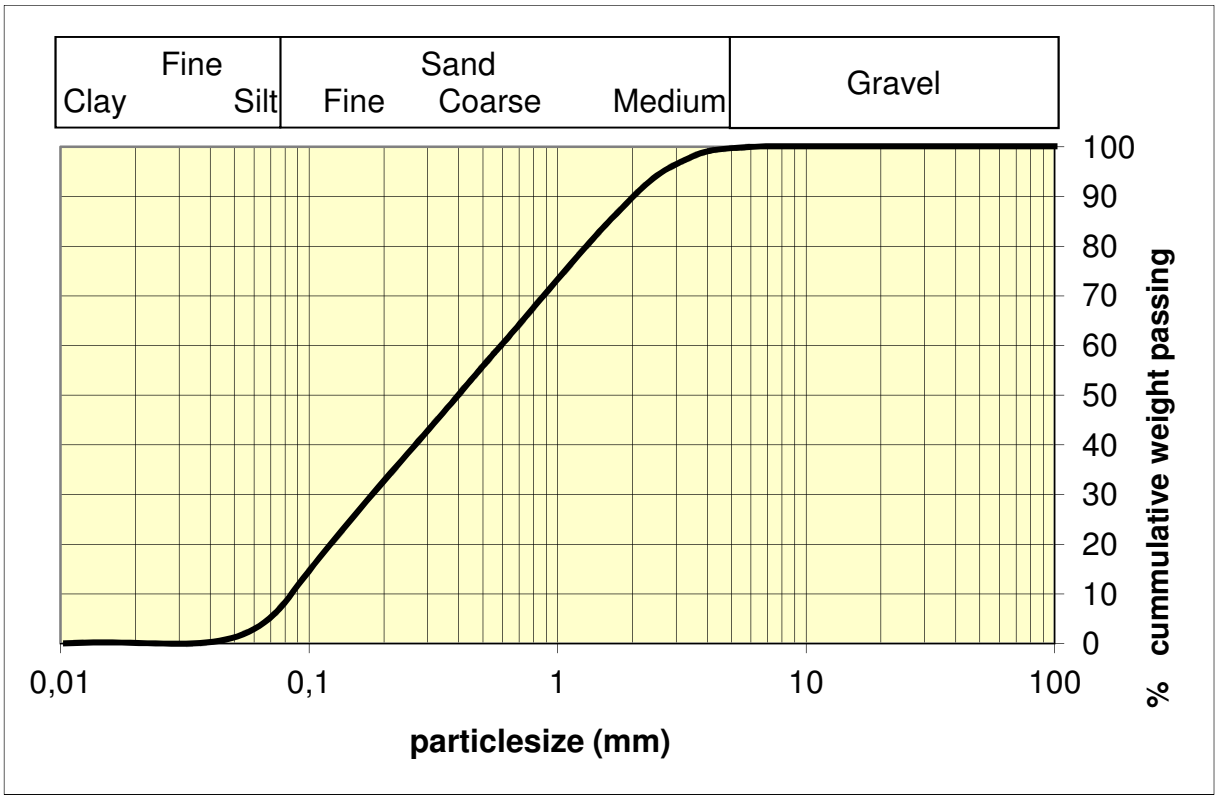


Figure 21: Sieve curve 0.4mm

Appendix H
Flood prevention plan

Contents

List of figures

1 Introduction

The goal of the Flood Prevention Plan is to make it so it can help the City of Manado overcome its Flooding problems, or at least the most urgent ones, in the next 5 years. The city of Manado with its half a million inhabitants has suffered from many flooding in the past few decades. In these decades the situation has only become more urgent because the rapidly developing city puts more and more strains on the drainage system and the river itself. Together with this the effects of Global Warming increase the strains on the system even more.

In the current state on average the river floods every 5 years and in some cases these floods are so severe that it brings people's lives in danger and even claim them. The people most prudent to flooding are the ones living in the weakest protected areas. In the Analysis these areas where already pointed out and in the Flood Prevention Plan they will be deled with by giving short term solutions.

Next to this also some mid- and long term plans will be reviewed and an opinion will be given. It can have lots of positive effect on the City as a whole to improve on these points and improve future planning. It also can be used to test the solutions on a shorter notice in a way that it will not intervene with future developments.

After proposing solutions in this report as a final remark some recommendations will be given. These recommendations will have several functions. One of these recommendations will be the need for more supporting research into feasibility or the true impact using advanced techniques that are beyond the scope of this report.

2 The need for a Flood Prevention Plan

In Manado the need for a flood prevention plan is of an urgent matter. Everyone in Manado will agree that the way things are now are not safe, and that the problems will return with the next big rain. The FPP (Flood Prevention Plan) is not a matter of luxury and does not only help the rich but in this case everybody can and must profit!

Together with the demands and the right to live in safety there are also some other triggers that make solving the flooding very important. One of them is the future, or better said the foreseen and wished development of the city to higher levels of standard. The City of Manado has made a slogan for how these goals should be achieved. These are the so called Visi & Misi (Vision & Mission) plans.

The *vision* plan contains the wish of the government to make the city more interesting to the greater public / tourist, as one may already know, one of the riches of Manado are the great abundance of coral and marine life. Also the nice climate – year round temperatures of around 30 degrees Celsius – makes it an ideal place for the tourist industry to grow. A way the government want to achieve this is by making the city of Manado a city for Eko Wasita (Eco Tourism). In this way it offers something more apart from sunny weather

The *mission* plan is traced back to one other big problem in Manado. The city has a big problem with garbage, and in particularly the handling and control of litter that isn't collected and most of the time just thrown in the streets or worse in the river. There have put a lot of effort in the solving of this problem. Until this point without any major success. It is an important point because it will repel the tourist they wish to attract toward the city. In combination with this it threatens one of their most important visitor spots, the coral and marine life round the Bunaken Islands in front of the Manado bay.

For the solutions the client has given some of his ideas and material already generated by him. The most important thing is that it must be considered that material and knowledge is limited and that the budget allows only for simple but effective solutions. The report is first short term oriented, the meaning of this is that in the next 5 years the plans should and can be realized. At the end of this report to some extend mid- and long term solutions will be addressed. Also the importance of the three plans working next to each other must be clear.

3 Flooding areas, an one-by-one approach

3.1 Introduction

In this part of the FPP there will be a rigorous description given of the most problematic areas in Manado. These areas were already discussed in the pre-going Analysis of the River. This time there deled with separately and in much more detail, in preparation for finding suitable flood prevention solutions.

The approach will start from the most Northern part of Manado, the Tumumpa area, towards the most Southern area, the Mouth of the River Sario. In total the approach will contain a description of 6 separate areas. Of these areas the Tumumpa and the Mouth of the River Sario are loose from the rest of the areas. The remaining four areas are all found in the Tondano-Tikala river system. This makes it one of the weak spots of the city's river drainage system.

Up front a notice must be given that in combination with the specific problems the general condition of most of the riverbank defences are poor. Most of them are made without engineering as emergency flood walls. The general perception here is that building the wall higher the better the defence is. From hydraulic engineering this is a classical mistake.

In the following part a short description is given and the area will be given a sharp round of critics to understand the underlying cause of flooding. In some of the cases the cause will be very obvious and hard to miss, but in some cases the cause will be less obvious and without further investigation must be assumed from an engineering point of view .

3.2 The flow areas

Up next are the description of the flood sensitive areas. In the figures the area outlined with the light yellow colour is the area that will struck case of a flood event. With the dark red colour the river flow area is outlined.

Within the possible solutions this story will be continued and solutions are explained in words and figures. This part is mending to describe the weak spots in all of the areas. And specify further the many possibilities to improve the system.

Tumumpa area

This area is located at the most northern part of Manado City. In the area one can see that it's partially occupied with households and on the northern banks a lot of tree land is found. The rate between land- and water area is approximately 70% /30% of which the smallest part is water area.

Figure 1: Tumumpa flood area

The area is also the end station for water from the Bailang river watershed. At this point the discharge will be highest and so the risk of flooding is. The shape of the river at this point is not the most efficient, this is because of level of meandering and also the relative sharp bends will cause serious hydraulic resistance. The area is divided in 2 problem zones. ONE is the zone where the biggest problem is the sharp bend giving an increased water level at the upstream part. TWO because of the almost 90° bend and the T-split towards the right in the figure the fast streaming water has the tendency to stream into the little river branch. In this way the little river gets pushed up and so the risk and severity of flooding in the river branch increases.

For the one area, divided two, it is not sufficient to only increase the riverbank height. To achieve a safe flow some structures must be engineered and build to steer the water more directly towards the sea (canalization). This is to relieve the banks from high water levels. Together with this the small river outflow should be protected from water entering from the main stream. Mainly to prevent a high backwater curve from forming

Paal Dua

The Paal Dua flood risk area is the most land inward located of the 5 areas. It is the first in line of the problems that are experienced along the Tondano river trail. In this case the land/water ratio is much higher. It is approximated to be 75% /25%, this makes the flood effectiveness much higher at this point in the river.

As in the previous piece on the Tumumpa area, the river shape is not ideally for draining water. In the highest part of the figure there is a 100° bend, in terms of flow effectiveness it causes a lot of hydraulic resistance. This is traced back to the area that is indicated as flood area. Because of the sharp bend one can expect that in the upstream part the water level will rise and thus flooding is aggravated.

Figure 2: Paal Dua flood area

Encircled is the bend and from the arrow the water will push into this sharp corner, causing extra water level rise upstream. The water from upstream can pick up lots of speed because the river in this part is (better) streamlined and water can flow more freely causing even better conditions for flooding. Assumed is that the outer bend of the encircled part is very well protected (because of an earlier flooding). In dealing with rivers it is commonly to see engineering solutions that will only move the problem instead of solving it.

To prevent flooding in this area one must think of solutions to prevent the backwater curve from forming in the upstream part of the area. This can be done by solutions that are implemented on site or by putting upstream structures to regulate the water.

Ketang Baru

The biggest flood area to have in Manado is the area in Ketang Baru, it is outlined in Figure 3. The total area represented is approx. 125.000 m^2. For this area the land/water ratio is about 80% /20%. In the area there is a big community of people so there is a serious need to solve the problem before the next big flood hits.

In the figure a large meandering loop is found. From upstream the water loops around a large part of the Ketang Baru suburb and the returns close to where it entered the suburb. The two only divided by a distance only 125 meters wide, in comparison the big loop is approx. 550/600 m long. In the figure this is marked with a striped line (in the right part of the outlined area). For easy explanation the area is called Ketang Baru TWO.

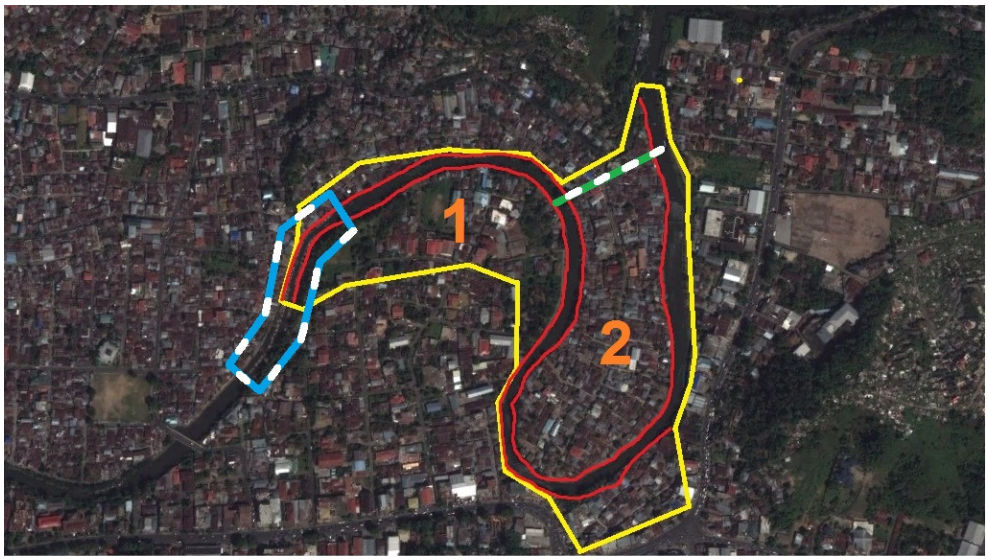


Figure 3: Ketang flood area

In the Ketang Baru area denoted with ONE there is a different cause of the flooding. In this area there is a lot of local fishing activity on the river, this is outlined in Figure 3 with a striped line. Within the area there are many fishing cages placed at both sides of the river. In **Error! Reference source not found.** the outlined area is zoomed in. Clearly one can see the narrowing of the river, causing serious blockage of the river. In Figure 3 one can see that area ONE is directly behind this. The obstacles make it possible that a back water curve is created and so the risk of flooding.

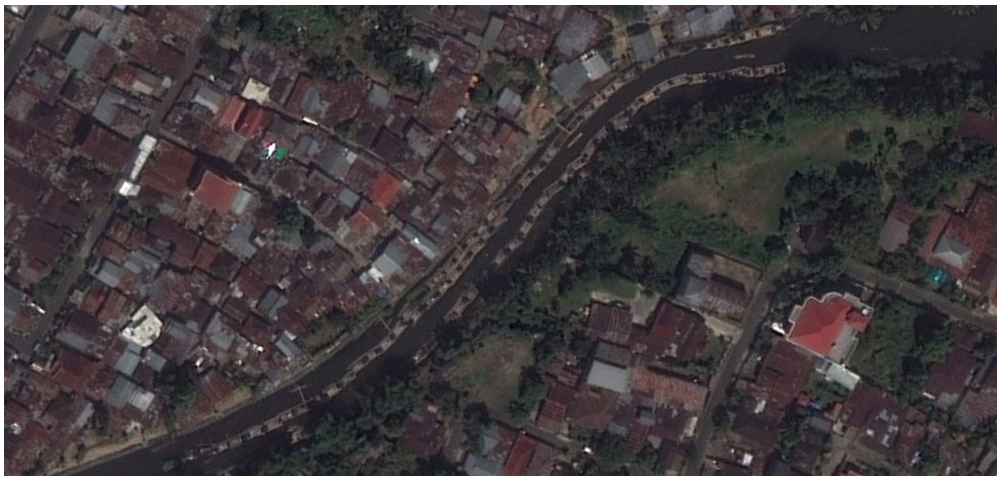


Figure 4: Hydraulic obstacles (Fish cages)

In this case for area TWO it is best that the water is set to flow more easily throughout this part of the river. “Shortening” the river and reducing the overall hydraulic resistance. For area ONE the most obvious thing to do is reduce the resistance by removing the obstacles.

Karame

The Karame flood area is located just after the Tondano and the Tikala River adjoin. The flow through of water in this part of the river is essential to the total draining of water from Manado. The area has a land/water ratio of approx. 70% / 30%. The land area is largely occupied by housing, but some open fields are found along the rivers course.

At first sight the problem in this part is not the meandering with sharp bends. Upon taking a closer look one finds that at a certain moment along the river the width reduces with more than 40 % (24.5 m → 14.3m) of the original. The funnelling happens over a course of 100 m , in terms of hydraulic resistance this forms a bottleneck in the system. The bottleneck can cause a backwater curve to form when there is a sudden large high water wave coming from upstream and it gets blocked by the narrowing. The water level upstream thus will additionally rise and enlarge the risk of flooding. In Figure 5 this narrowing is encircled with a striped line.

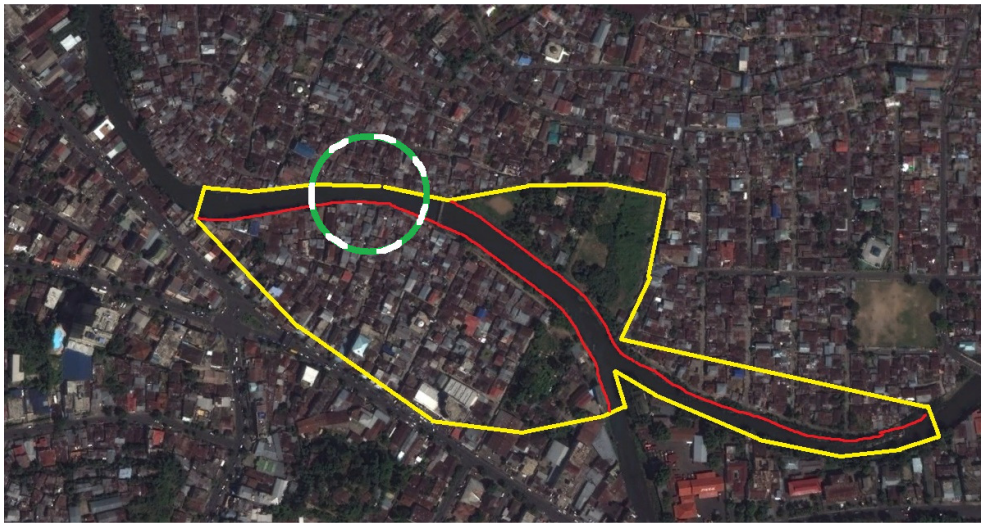


Figure 5: Karame flood area

The flood area shows a tail that reaches a few hundred meters into the upstream part of the Tondano River. An explanation behind this is not confirmed, but one can think of the protection of the Tikala river at this point is better (read: higher) and thus doesn't flood and the Tondano part has a weaker flood protection and thus does flood.

In general the solution here is a combination of widening, if possible, and an updated river revetment so it can hold off high water levels. A warning must be given that by widening the part outlined the risk of moving the problem downstream is present. Good investigation if parts further downstream should also be widened is a must at the point.

Tikala Baru

The Tikala River has one area that is indicated as having a high risk of flooding. The flood area exist mostly out of housing. In addition also some industry is located within the outlined area. The land/water ratio of the area is approx. 80% /20%. The area as much of the pre-going flood areas is a strongly meandered piece of the river.

Together with some fairly sharp bends, probably not the main causes because there are also some constrictions. At the moment of taking this satellite image there was a low river level. The main obstructions are denoted with ONE and TWO in Figure 6. On both occasions the width of the river is suddenly reduced with 50% or more. And as in the Karame area a backwater curve will start to push-up water levels at an upstream position.

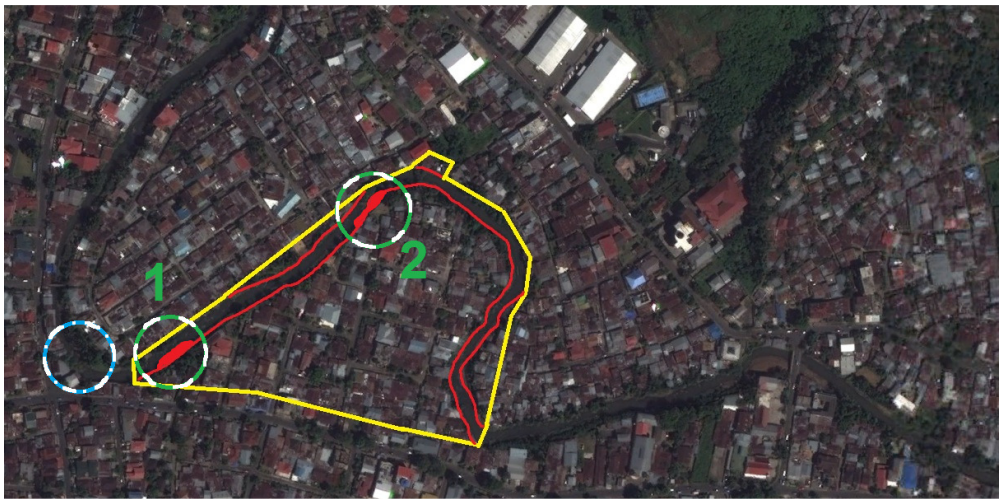


Figure 6: Tikala Baru flood area

In this case also some of the first measures that can be taken is to remove all obstructions from the river. This will help to reduce the most immediate risk of flooding. In addition more measures can be taken to reduce hydraulic resistance. There is a third circle (stripe-dot-stripe) that lays outside the problem area, but in its own turn can cause also a backwater curve that will more aggravated a flood in the Tikala Baru area.

Mouth of River Sario

The last area of interest is located, just as the Tumumpa flood risk area, at a river outflow that is in open connection to the sea. The land in risk of flooding is one of the smallest of the 6 areas. Together with this also the use of the area is mainly for anchoring small fishing boats (tugging them on land). Housings are hardly found in this small piece of land. Older imageries show that this open piece of land once held housing but probably pre-going floods already destroyed these. And in response people did not build new houses. In Figure 7 the area is outlined and the river course is marked. The land/water ratio of this piece of land is 50%/50%. This river mouth is for the largest part responsible for the Sario river outflow, from earlier research it became evident that beyond this flood area also the land behind it has not been free from flooding in the past. In this case it is not treated as an area with a high risk of flooding but it should be monitored if things are starting to get out of control.

Figure 7: Mouth of River Sario flood area

The mouth of the river as outlined with the striped line. It shows that it's not well maintained and lot of sedimentation is already collected in the mouth and under the bridge. This sedimentation forms a serious hydraulic resistance for outgoing water. Together with this the upcoming tide also plays an important role in causing floods.

The sea side part of the river mouth is a highly dynamic area in terms of underwater shape and outflow effectiveness. With every sea storm / big rain fall the bathymetry of the mouth will change, this will not always happen for the good. So a big note here is to up the maintenance of this part of the river. In general this part of the river can use a facelift in terms of improving the flow through, this is valid for both sea and river side.

Flood areas summary

To give an overview of the detail area analysis a table is made. In the following table the problems are summed up, knowing:

FLOOD PREVENTION TARGET POINTS

WEAK POINTS / DESIGN SUGGESTIONS

	LAND/WATER	AREA (m²)	WEAK POINT	SUGGESTION
TUMUMPA I	70% /30%	3750	>90° bend	Smoothen/ improve flow through
TUMUMPA II	70% /30%	3750	T-split	Introduce a 'bend' construction
PAAL DUA	75% /25%	5000	>100° bend	Smoothen/ regulate flow through
KETANG BARU I	80% /20%	75000	Meandering loop	Shortcut waterway
KETANG BARU II	80% /20%	50000	Hydraulic obstacles	Remove obstacles / improve flow through
KARAME	70% /30%	10000	Bottleneck	Widening of river / regulate flow through
TIKALA BARU	80% /20%	15000	Hydraulic obstacles	Remove obstacles / improve flow through
MOUTH OF R. SARIO	50% /50%	5000	Sedimentation	Improve maintenance / layout
		167500		

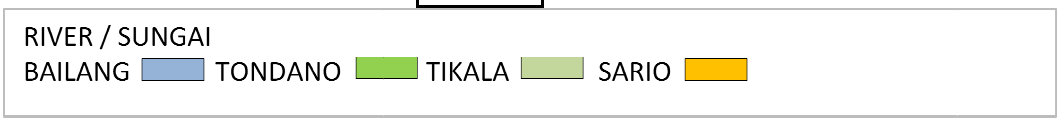


Figure 8: Overview of one-by-one analysis

In Figure 8 the results of the pre-going detail analysis. Together with some facts also some of the outcomes of the pre-going text is pointed out.

The general system behind the flooding problem are parts of the river that are causing a backwater curve. A backwater curve is generally created by a sudden narrowing or blocking in the river. Backwater curves are important to one who wishes to understand the behaviour of water flow in a river.

The trend in solving these problems or the general advice is to remove the blockage or improve the flow through. Together also ‘smoothening’ of bends this can help improve the flow through, because there are some very sharp bends in the river system in Manado.

4 Possible Solutions

4.1 Introduction

Within this section one can read about some of the possible solutions that are suggested to the client/reader. Possible stands for the high probability of being a right solution to the problem. When deciding upon solutions multiple factors play a role and some of them won't fall within the criteria of 'possible' solutions. For example in some cases preservation of the scenery can be criteria that will not fall within the term 'possible'. It is for the client/reader to decide which of these solutions fits best to ones needs.

The general focus within the possible solutions is that they are of simple nature, making the cost of realizing low. Second they should be realizable within a short timeframe, this being from the drawing board to the finished structure within no more than 5 years.

5 Short Term plan

Because a lot of the problems have a common cause the solutions are given for the different problems. For the solutions it is tried to look for the simplest yet effective solution(s).The conclusions from the one-by-one analysis are used to come up with these suitable solutions.

5.1 River bend improvement

Tumumpa area 1

For this area it is reckoned that the bend is made as smooth as possible. And remove a lot of the obstacles that contribute to the hydraulic resistance. As already said the bend is very sharp and is located at a point in the river were the discharge is crucial, just before entering the sea.

At the moment most of the revetments are the original that were formed by nature. Especially in the outer bend this is the case. The solution is shown in the figure below, in it the smoothened revetments should be placed approx. where the striped line is.

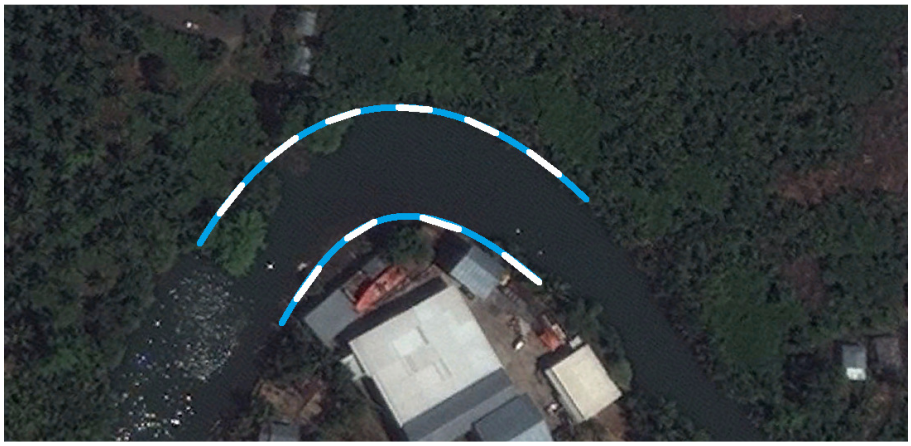


Figure 9: River bend protection / smoothening

Together with the bend improvement the river must also be cleared of other obstacles. This will make the solution at the crucial bend more effective. The improvement can also be of a larger project to canalize the whole downstream part of the river (the area within the city borders).

Tumumpa area 2

For the second area it is advisable to build a construction that is in line whit the solution given for area ONE. For the solution of area TWO there only is a crucial difference , for this area a side river outlet should be taken into account. The side river cannot just be closed off, and the flow through it must be maintained.

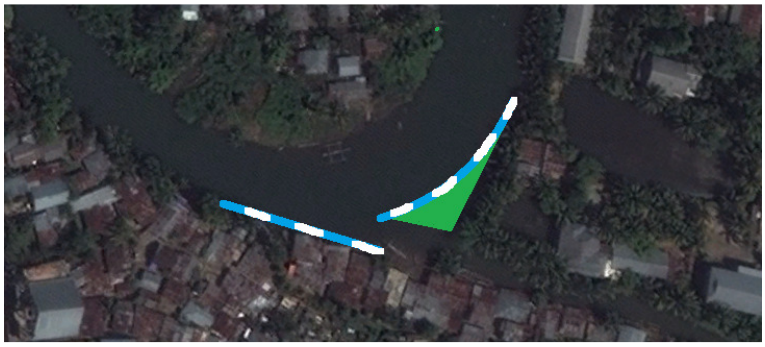


Figure 10: River improvement with opening for side river

In this way the water is also stopped from flowing into the side channel. The river is steered inward towards the downstream of the river so that the water from the side river experience less resistance and can hitch on to the bigger Bailang river.

5.2 Bypass storm water drain

Paal Dua

At the side of Paal Dua the biggest problem is the sharp bend that is 2/3 of the way into the river that falls within the flood risk area. First a ways has to be found to improve the flow through in the bend by putting up new revetments following the Tumumpa area ONE. Second an alternative solution could also be a solution to prevent the area from flooding. In this case a storm drain pipeline could be build to bypass the bend. In the figure a schematic representation is given of the pipeline trajectory and the river bend improvement.

Figure 11: Improvement for the Paal Dua flood area

in comparison the pipeline is somewhat shorter than the original course of the river, if well engineered this should not be a problem. The pipeline also doesn't have to be permanently opened. it can stay closed off during the dry season and open during the rainy season or situations with lots of discharge from upstream. The flexibility of implementing storm water drains can also be part of a larger storm regulation plan.

5.3 Widening of the river

Karame

As example of widening the river a look will be given to the Karame area. In the one-by-one analysis it was concluded that this is main cause of flooding of the area. On multiple occasions the river has been narrowed to hold housing. From the satellite imagery it clearly visible that the house are built on or just next to the river's edge.

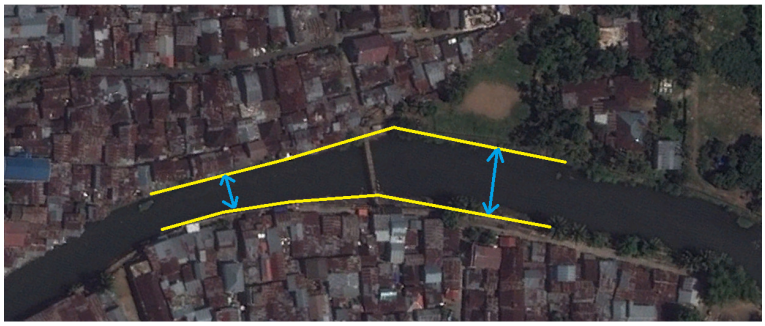


Figure 12: Funnelling in the Tondano/Tikala River

A simple solution is to widen the narrow part of the river to match the width of the incoming stream. This however is not always possible as shown in Figure 12. A second one will be improving the flow through effectiveness by reducing the resistance coefficient. All of these solutions can be very costly and/or give hindrance to surrounding villagers.

Solutions can also be found by deepening the narrow part of the river until a sufficient dept so the conditions match that of the incoming upstream river. It is advisable that whatever the solutions might be it will form a good hydraulic connection with the upstream river part as well as the downstream river part.

5.4 Solution summary

Above about three kinds of solutions were explained and illustrated. In the pre-going analysis the future plans of the Manado city river problems was already addressed shortly. These plans are not quite different from above given solutions as being plans on short term notice. The canalization of the river has a big advantage as it will become more uniformly and the capacity can be better determined and controlled in a way. Only these plans were/are focussing on the Tondano and Tikala watershed areas and leave out the other rivers.

To ensure a safe flood free future next to short term planning also a master plan for mid- and long term safety plans. The master plan is a collection of all plans that bridge the next 25-30 years (as being an averaged long term lifespan). In the plan a global impression is given how the several term solutions enhance each other or why they were planned the way they did. To not only stop at the short term solutions and create a broader look on problems.

6 Mid-term Plan

To be sure the next 5 years the risk of flooding is minimized short-term solutions prove to give sufficient coverage. The small correction in the system must give some protection against flooding. In the pre-going piece on possible solutions one could read that for the investigated problems 3 types of solutions where discussed, knowing:

- River bend improvement;
- Bypass storm water drain;
- Widening of the river.

The solutions given concentrate on a very local scale by looking at the weakest points in the system. These solutions only respond to a precondition of the river, a known highest river discharge. For short term plans the material/funds and building time are very low. The risk probability however at this point is very high, and if for instance the design of these local solutions is based on a one in five (1:5) year discharge condition (expected) the probability of failure will also be of the same order of magnitude.

Of course this is not really a risk magnitude that will assure people that their safety is guaranteed. A temporary solution can have its advantages if funds or material are not available at the time. This short term solutions will be a good alternative if the other plan is to do nothing until sufficient means are available. With such a strategy the one responsible will take a big risk because if the risk of flooding is almost once a year there is little or no time to “wait” for the solution to come to one self.

The city government of Manado has already proposed a mid-term plan. Mid term, planning has a time span of around 10 years, it is more abstract from the practical solutions in the short term planning. This plan is called the ‘Urban Flood Control’ plan. In the pre-going Analysis this plan was already mentioned as one of the future measures to prevent flooding in Manado. The global idea of this is to improve the hydraulic resistance and heighten the floodwalls over a course of 14 km along the River Tondano. In addition to that the following description is given in points of what the complete plan holds, knowing:

- Construction of flood embankments;
- Strengthening the cliff, river normalization (canalization);
- Placing a dam, constructing a reservoir and a multipurpose flood control in order to hold the flood flow and reduce peak flood flows;
- Socialize / introduce and develop the wells.

These plans are very ambitious and from the involved parties point of view this will surely satisfy the flood safety for the next few years.

The main focus of this project is to protect properties in the city of Manado. The plan is directly implemented in the current situation and no social or environmental effects, for so far known, are taking into account for the river system. Actually this won’t be a problem if one look at safety only the next 10-15 years. But the question if it is sustainable and is it waterproof against any sudden side effects? The flexibility of just building revetments can be disappointing. For instance if the height will prove to be insufficient at some point in time. To just heighten them even further will bring more risk and will disregard any of the ‘pleasures’ one can have from having water flowing thru a city.

The plan has been really focused on the protecting against flooding, and thus bigger is better, but is it? The climate in Manado can also be very dry. In these times small discharges are seen and the river will look very sad. A good example of this are the big storm drain channels found in some of the US cities. When found dry they give a very “grey and concrete” view.

Figure 13: Flood channel Houston, Texas, US

To keep the original feeling of the rivers in the city without making them big and ugly one must think of another solution..

Executing the Urban flood control plan as it was originally meant can endanger or impede the goals of becoming an eco tourism city. To improve the embankments and river bed with measures that will relieve hydraulic resistance is certainly something one can think of when thinking of river improvements. But one must keep in mind that the social impact on the city must be kept as low as possible.

As a parody on the ‘urban flood control’ one must better think of the title ‘urban water control’. As already said the plan to build structures only focused on flood control instead of the whole water system, for example during the dry periods can be devastating to the cities attractiveness to people from outside as well as the inhabitants themselves. One could better choose for ‘invisible’ structures to keep flooding from happening. With these invisible structures it’s not mend that the solutions are out of sight, but that they are made to have a positive addition to the surroundings.

6.1 Urban Water Control

The Urban Water Control plan is one solution that deviates from the existing plans. In many terms it is will have commonalities with the Urban flood control plan, but with some key differences. Up-front one must keep in mind that this idea is far from ready to implement but tries to give the reader a broader perspective on the problem.

To start one must consider the total picture of rivers in Manado. Because of the very intense rainfall climate large difference can occur in the river levels. This is also the ideal situation in which the so called Flash Floods are born. The system thus has to be very robust to withstand such intense and fast increases of water levels. In this way the Urban Flood Control plan fits this description. But then come the (long) periods of low discharge levels.

In the current situation in some places during the dry periods the water level will only be a few centimetres. Making it easy for sediment and trash to come to rest on the bottom where sedimentation will cause al sort of different troubles. This cannot be solved by only heighten the embankments. Because if enough sedimentation is trapped and the “fast” flash floods comes by the danger of flooding is very big. In addition to the rapid water level rise the sediment outwash will always have a delayed response so in the first period of the big discharge the revetments designed with a specific channel depth have to deal with a higher bed level making the risk of flooding increase. After some while the sediment while give way and conditions return to design specifications, but one could imagine that this will make the situation not any better.

Second, at times of low water the river level will be so low that parts become dry. This in combination with the sunny warm weather will cause a stance reeking throughout a whole neighbourhood. This is also partly due to the scale of garbage that is thrown in the river. The ideal situation would be to a set minimal water level that is maintained by controlled discharge from river entrainment basins

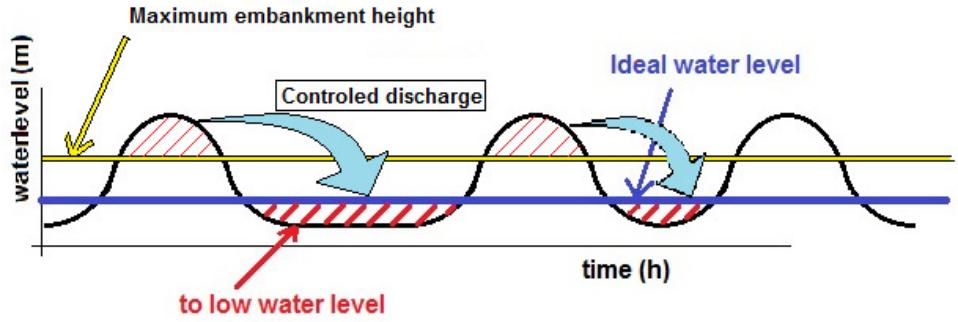


Figure 14: River discharge curve (with modifications)

These entrainment basins must be sufficiently large so it will never happen that there is no water for the controlled discharge. In Figure 15 an example is given were one can imagine the entrainment basins along the river (in this case only the Tondano and Tikala river area is considered).

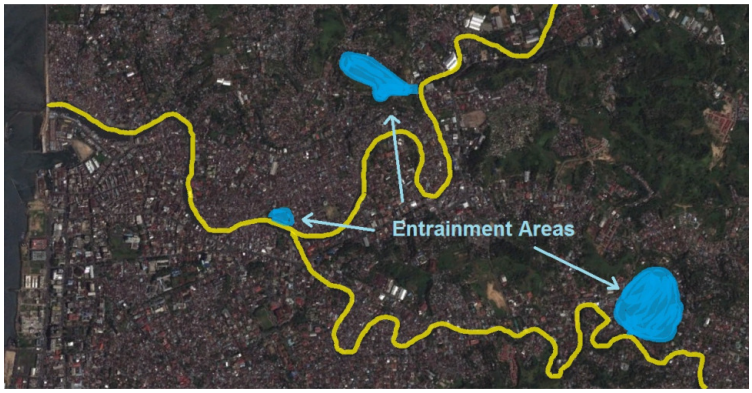


Figure 15: Entrainment basins (example)

In the city the options for basins are very slim because a lot of area has been asphalted. In the city of Manado little or no room is reserved for green accommodations or water places, except the rivers. Another option is to build underground storages but at that time it will become very expensive and complicated.

The plan of controlled water discharge will incorporate the design of some sluices and control mechanism. This to further ensure a water level without many fluctuations throughout the river system. An example might be small dams or overflow structures. Especially the hilly part of Manado will need some extra attention during the engineering phase because here the level is harder to control than in the low lying relative flat areas downstream.

If enough storing capacity can be achieved inside as well as outside Manado (Tondano watershed) the system can be very robust and if it might be that lower or higher periods of discharge are expected (weather prediction system) the system can be adjusted to cope with this.

7 Long-term Plan

After having said something about the short- and mid-term options there is one last and that is long-term planning. Usually the time span for long term is set upon 25 years. This just depends on the kind of project. A long-term plan is almost never a strict plan. In 25 years a lot can happen and so most long-term planning have a dynamic character and can have revisions every so many years, for the ease of it 10 years is taken as revision rate. In the figure below a schematic representation is given of such planning strategy. (5 years = short term; 10 years = midterm; 25 years = long term)

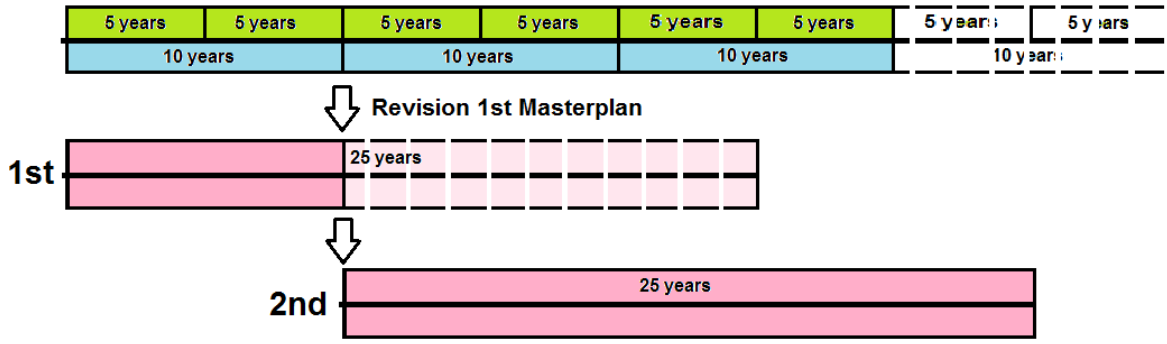


Figure 16: Planning Strategy

Long term can be very useful because it is meant to test all sorts of 'what if' scenario. For the hydraulic conditions a lot of data is available, especially data that is orientated on climate change. One of the most important factors for collecting data to make a long term planning is that it contains a lot of processes that will continue on for the expected time span and beyond.

In contrary to some western countries and the USA where the data collection has started since the industrial revolution the developing countries have been lacking behind on this. This is because there was first no need for data collection as a lot of communities lived apart from each other and lived like they did for many centuries before. In modern time the demand for correct and sufficient data is much higher only the thing nowadays is that there is not enough money to finance such projects.

But as an old Dutch saying says: " we moeten roeien met de riemen die we hebben" (freely translate the meaning comes down to it that one has to do with whatever means are available). So for this moment a lot of thinking has to come from experience unsupported by data. The collection of data however is always and will always be crucial for confirming a hypothesis or data that was assumed in first. Point one in long term planning thus is the generation and collection of data that maps long term effects.

7.1 Scenario generation

For a long term planning it is not sufficient anymore to take information from collected data. In such a case it has to be generated with the help of scenarios. This doesn't mean that the more scenarios' generated the better. It is advisable that this is done by experienced engineers first before other parties go ahead with the data to set up future plans. These scenarios don't have to be only for the benefit in preventing flooding, there are many things that river data can be helpful for. The scope however limits it for now to the flooding/water control problem.

In the pre-going analysis there was spoken of the subject unpredictability and intensifying of rainfall due to climate change. These are excellent subjects you can take into account for a long term analysis/planning because nobody really knows how it will precisely be in 25 years from now but some accurate assumptions can help out to solve difficulties. So to sketch one scenario one must take into account the intensifying of the rain falls and also make some crude prediction when and how the trend will continue itself in say 15 years, 20 years and so on. This al helps to make the midterm and short term have smaller chances of being off and saves in having to make costly corrections.

7.2 Room for the River

One of the best examples of a complete report containing maybe all possible things one can expect from a master plan including long term effect is the Dutch report on their rivers; 'Ruimte voor de Rivier' (=Room for the River). The river Rhine where the report is mostly based on, is a different story from the Tondano river (Rhine at some points is 500 m width(!) and has an expected discharge in the next 50 years of 18.000 m^3/s (!) at the most extreme situation. And at the same time there are many similarities. So is it that both expect higher discharges in the future and both systems need optimization of the system as it lays there today. Rather without then with large and complex measures.

Good thinking and researching of future events can give a head start in developing plans that need a lot of preparation. In the case of Manado the frequency of flooding on a major scale is once every 5 years. if with the short term solutions this can be brought back to an every 10 year cycle. The government buys time to make plans with a longer time span. Because large projects cost a lot of money and there is never a 100% certainty it will work one must already aware of the dangers and risks so good preparation is a must.

This is just what the report is doing and even more. Within the report the plan is also looked and judged from several points of view, knowing:

- Flooding risk / Damage;
- Political;
- Environmental;
- Spatial planning (Reserving / buying up project land for future development).

This to prevent side effects from happening, which can have devastating consequences.

The city of Manado is advised to take a closer look at these points in a long term setting. Although it's already difficult and hard to implement to aid the most urgent matter so that long term planning cannot or will not be considered. because of the immediate risk of flooding in oneself opinion the first two points are discussed vigorously. But the last two are less thought off, and let these two points can play a big role considering long term effects.

In the midterm planning part some of these points where already pointed out, and this will hopefully be made clearer in this last part.

8 Conclusion

The Flood Prevention plan is a collection of ideas and opinions given by a small group of engineers. In it the report it is made clear why there is a need for solutions. People don't really like to have their feet wet or their houses destroyed by flood that could have been prevented where there taken action.

The plan takes the solutions from a local direct level, knowing the short term plan. At this level the most immediate problems addressed with a practical solution. The main focus is on short engineering time and a high/fast realisation rate. The plans should be realizable in a period of about 5 years. A quick but temporary fix, in the short term planning not much is done with prognoses of future scenarios.

Midterm planning already is a step higher on the planning scale. The usual time span of this is about 10 years. The plans already made by the city of Manado are made with great care, but with the plan as it is now some important ways of looking to the problem are forgotten. The biggest one, the visi & misi goals. Also the city will clearly not get more attractive by just building big and ugly constructions. The example of 'Urban Water Control' is a way to look at this in the mind a broader perspective.

Last up are some of the Long term planning strategies. In this the collection of data and the improvement of data is crucial in better understanding the consequences and the reaction of a certain water system over a longer time scale. Also the short term and midterm planning must be closely engineered with keeping in mind the long term results. Solution this way will become much more effective and save head breaking problems in the future. Long term is mostly the product of abstract thinking like 'what if'. Also side effects play an important role here. Side effects, if misunderstood, can have very costly or worse, dangerous consequences.

The combination of this three must form a Master plan. Such a plan is essential to the overall health of a city. Especially one that has set a goal for itself to undergo large developments and next to that also do more then only staying within the basic needs of a city to function.

9 Recommendations & Advice

The report has produced some recommendations and advises to tackle the problem of Flooding in the city of Manado and help it inhabitants to live in safety and keep enjoying their beautiful city.

The recommendations/advices are given point-for-point, knowing:

- The need for a solution is more than obvious. Because of the immediate danger of flooding with the next big rain it is recommended to fix the situation on short notice with minimal involvement of structural changes to the system.
- At the same time that these short term 'emergency' changes are done to the system there should also be development of the mid-/ long term planning. And the first, short term, measures taken should be in accordance with the mid- / long term plans.
- On the level of midterm and long term plans the social impact and the effect on the environment should be given much more attention. Especially on long terms bad decisions on the level of short- and midterm planning can have unwanted consequences. This is why the total must work next to one and another so that planning problems can be detected in an early stage of the process.
- Always try to put problems in a broader perspective. An good example of this is the plan 'Urban Flood Control' the goals within this are very clear but to ones opinion it loses contact with the bigger picture of general water control in the city and let misses some opportunities supporting goals in city development.
- Even with limited resources, in particularly money, the most basics of research must be kept going. Because this has the potency to prevent or limit unwanted side effects and save money on the longer run.

In addition to this the report before you is surely not a free ticket to a total solution for problems in the city, but it can be kept in mind that by thinking just one step ahead some of the opportunities that are out there can be used to realise the wished development without having to take a step back and correct for bad solutions in the past.

Appendix I
Manado Beach

Contents

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1 Introduction

In the past two decades Manado city has expanded. Since the early nineties several land reclamations have been made along the Manado coastline.

Before all that the house, now facing the Boulevard road, were facing the sea side. In front of these houses there was a sloping shoreline with nice sandy beaches and places with beautiful coral. Places for people to recreate and to meet each other.

Nowadays these houses face the big shopping malls and from the city the sea is barely visible. Also there are recreational places along the shoreline any more. People just 'meet' each other in the shopping centers.

The people of Manado are in need of new recreational facilities, preferably along the sea side. Taking that into account, there is nothing better and more relaxing as a beach.

Therefore, in this report a short impression is given why, where and how a beach in Manado can be created so serve the need of recreational space.

Figure 1: Future Manado Beach?!

2 The need for a beach

Manado City is one of the major cities in the north of Sulawesi, surrounded by several volcanoes and in the middle of a lot of green and untouched nature. Also, Manado has one of the most beautiful pieces of nature one can think of, Bunaken Marine Park. This is one of the top five diving spots in the world.

Together, these two things are probably the most important. However they are not the only two things that ensure tourists will visit North Sulawesi and Manado. They will not come because of the overwhelming tourist attractions that Manado, as a city, has to offer. This, because of the simple fact that there is almost nothing to do within the city, except shopping along the boulevard.

But within the city of Manado they want to change that; the city has a vision and with that a mission:

Visi: Manado kota model ekowisata *(Manado city an ecotourism model)*
Misi: Menjadikan Manado kota yang menyenangkan (Make Manado city a pleasant city)

This means that they want to change the appearance of the city to make it more attractive to visit as a tourist. Some say they want to make it the second Bali of Indonesia. However, among a lot of things like making the city cleaner, more organized, more save, they need to create accommodations for these tourist to enjoy their stay in Manado. Even if these tourist are coming for the diving and they stay only in Manado city for the night, they want something to do and to relax in the evening hours.

This is the point at which the title of this chapter comes into play. A beach is a perfect mean to recreate people. During day time, people can relax on the beach, enjoy the sun, enjoy the sea and waves, take a swim or snorkel. In the evening, there is the sunset to enjoy, stroll some along the waterline, take a rest after a day of diving or other activities, drink something and enjoy a nice quiet evening. All things, tourists would like to go to the beach for.

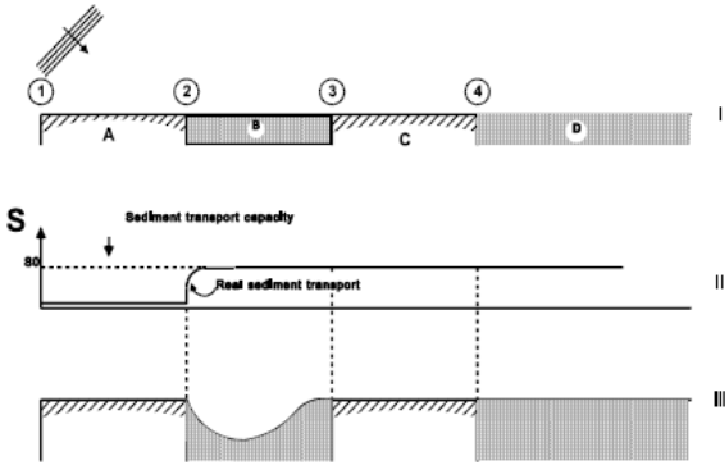
However, not only the tourists would enjoy the existence of a beach. Also the local community would love to have some space to come together and spend some time with friends. According to the youth of Manado, one of the top five of annoyances about Manado City is the lack of recreational space. Areas without buildings, without shops. Just open air, to meet people, to chat , to drink and eat something. Nowadays there are just a few of these places and almost all the kids and youngsters go into the shopping centres, to hang out.

For them, a beach would be an ideal place to hang out after school or at night, to drink and eat something at the sea side. Give them a space for their own. Of course looking at the economic interest of the beach, also companies should be interested in the development of a beach. Creating a beach means a lot of recreational space. A lot of people will enjoy that space together. And when laying on the beach, people want something to eat and drink. So for the local food stalls, this would be an enormous opportunity to earn easy money. At night, when the youth is coming for recreation, also drinks and food are needed. So several times a day these food companies would enjoy the existence of the beach.

So according to the previous mentioned points, the advantage of a beach is very big. Attracting more tourists and make it more enjoyable to stay in the city of Manado. Creating a recreational space for the Manadonese youth to hang out with friends. And third, creating income for the local food stall and restaurant owner. So what would be the problem of creating this beach in front of Manado besides the technical design possibilities?

There are several environmental opponents that are against the land reclamation along the shoreline of Manado City. Not only does it destroy the existing coral over there, but it also has an effect on the current along the coast, and with that on the transport of sediment. But, this is not a land reclamation like the ones that are built until now. The existing reclaimed land has a hard sea defence structure everywhere, like a concrete wall or a rubble mount protection. All of these constructions change the sediment transport along the coast and they will not adapt to create a new equilibrium. Because of the fact that natural adaptation, like erosion and sedimentation, is not possible anymore at those places, other places will start to erode or accrete. Places that are not used and certainly not prepared for that.

The creation of the beach will not cause severe problems and can possibly even help in solving the other erosion problems. Of course when one is creating a beach, the contours of the coastline will change and with that the existing current. But a natural coast line, without a hard protection, can adapt itself and can create a new equilibrium more easily, together with the new current. So the damage to other parts of the coastline will eventually be minimal. Only in the adaptation period, just after creation of the beach, there will be a difference in sediment transport. This is because the beach will erode and accrete until it reaches its equilibrium state, together with the currents and other factors that influence the coastline, for instance the wind.



ansport capacity

By creating a beach, there is a chance that there will be a larger sediment transport rate along the coast after the nourishment of the beach. This is something that has to be investigated. But it is not something that in definite is a negative thing. A larger transport rate can help in resolving the erosion problems in the north of Manado Bay. The sediment possibly will be taken from the beach area which means that the nourishment needs maintenance to keep the beach in place. The sediment taken from the beach will be transported to the north, where at this moment erosion occurs. This erosion partially occurs because of the transport capacity of the current. It wants to transport material, and it will take the material away from the weakest spot, in this case the area near Molas. This is elaborated in another chapter of this report. But if it can take the sand from the beach area, the northern parts will be spared of erosion.

3 Possible location of the future beach

To create the beach, one of the first things that need to be done is an investigation into the possible location of the beach. Around the coastline of Manado there are a lot of places that are not suitable for the creation of a recreational beach.

Along the coast there are several rivers flowing into the Manado Bay. Around these river mouths, it is not desirable to create the beach for several reasons. One of those is the presence of a rather strong current that will partially take away the sand (in addition to the ocean alongshore current) from the beach. However, there is even a bigger cause why it is not suitable to create the beach next to the river mouth and the reason for that is the garbage.

When there is a high discharge in the river, mainly in the rainy season, this garbage flows out into the sea and partially ends up on the surrounding shoreline. This is not something that one wants at a recreational beach.

Looking at the rest of the Manado coastline there are several stretches that face the back side of the big shopping malls, along the Boulevard street. Although these stretches are sheltered by the big buildings and therefore are rather private places. For tourist it is not a very pleasant sight to look at a big concrete wall when laying at the beach. On the other hand, if these shopping malls can change the appearances and adapt to a possible beach, they can possibly earn money out of it.

Besides the big buildings along the shoreline, there are several stretches that have a small boulevard road along with, on the other side of It, several restaurants and bars. They're located quite far away from the back side of the shops along the Boulevard street. The stretches of coast are the best usable for the creation of the beach. They are easy accessible, have quite good parking facilities, have some food and drink facilities nearby and do not look on the back side of a big building. It is even possible to create a not motorized area along the beach so people can recreate on a rather quiet piece of Manado, meaning without a lot of traffic, and feel safe to do so.

One of the best places to do so, is a stretch of coast behind the MegaMall, between restaurant The Club and the McDonalds, indicated in Figure 3 with a red line.

Figure 3: Location of the possible beach

Below several figures are given that give an impression of the location as it is at the moment.

Figure 4: Back side of the MegaMall

Figure 5: Boulevard street along the coast

Figure 6: Boulevard street along the coast 2

Figure 7: Coastal protection at the beach site

Nowadays, this is already a very popular area. During the day there are a lot of people going for lunch at this strip, and just walking along the sea side. At night it is a place where the teenagers of Manado come together to relax. There are several places of entertainment in the area from where people are visiting the coastal strip at night to meet each other.

Also the surrounding entrepreneurs are ideal to have around such a beach. On the north side of the strip one can find the McDonalds. This is for many tourists a well-known company at which they feel familiar and where they like to come. Also in the north there is d'Terrace, a not that expensive restaurant and lounge where one can relax. In the south there are several more luxurious restaurants, with The Club located next to the future beach.

Besides the food and drink places, there is also a (karaoke) bar close by, and for shopping there is the Megamall.

All these entrepreneurs can benefit from the existence of the beach. Not only by direct selling at the beach, but also from the business on the beach, which attracts other people.

Because of the fact that they are profiting from the existence of the beach, it might be an option to involve them in the development of the beach. For them, it would be beneficial to get some participation in the project and design, but mainly to let them help to develop the beach and partially to involve them in the financial part.

Besides the already existing companies in the surrounding area, local, new businesses can be attracted to join the development of the beach, financially and constructive. These companies like the small food stalls, which are easily created. They also can earn quite some money with drinks and lunches and can be involved in the pre phase of the development.

All the above mentioned points entails that the development of the beach is not only the concern of the government, but also of the companies. The more they put into the beach to make it work, the more they will retrieve from it.

4 Survey

4.1 Depth measurements

On the location of the beach between The Club and the McDonald's, a simple survey is done. By diving, the depth at six different location is measured, by means of a dive watch with depth indicator. Also a camera is used to record several distinct objects around the 'bay' to check distances later. Most of the distances were measured with Google Earth. These are not really accurate, but give a good indication and are well enough for a preliminary calculation.

pth measuring with
n

Figure 6The location of the possible beach contains a small sheltered area behind a break water (Line A in Figure 9) of about 70 x 100 meters. The remaining part is a coastal stretch with a total length of about 200 meters, until the McDonald's in the north. (Line B inFigure 9)

Figure 9**Error! Reference source not found.** indicates the 6 spots where the depth measures have been taken.

The results are shown in the following table.

Depth at several diving spots	A	B
1 (9 meters from top of coastal protection)	6,5m	6,5m
1 (50 meters from top of coastal protection)	7,5m	7,5m
1 (100 meters from top of coastal protection)	7,0m	9,0m

Table 1: Results of dive measurements

As can be concluded from these results, the average slope of the bottom in this small 'bay' is about 2,5/100 = 1/40.

Further seawards, about 300 meters, the bathymetry will become very steep (about 1:8), according to several data sources.

During the depth measuring, a clockwise flow was experienced along the coastal strip. This current is directed towards the sheltered area behind the breakwater. The average flow along the entire shoreline of Manado is South to North. This indicates that the breakwater creates some kind of eddy behind it, directed clockwise.

4.2 Existing coastline

Figure 10: existing coastal protection

The existing coastline has a quite heavy protection against wave attack. On average, gradations of 300 – 1000kg and even 1000 – 3000kg are used (according to the European EN 13383 standard rock grading). The complete coastal stretch is covered with layer of large rocks (rubble). The problem is that in Indonesia, they do not work according to a strict grading classification. The quarries do not make that distinction. It must be heavy enough, according to the calculations. So for in further design, calculations have to be taken into account that a very detailed classification of layering is often not possible. On average the top of this construction lies at a height of 3 meters above the HW level.

At the south side of the coastal strip, next to The Club, there is a small harbour / jetty with several boats. Among them, there are a few small fishing boats, some diving boats and a police boat.

4.3 Marine life

When diving, several discoveries were made about the marine life along the coast. The coastal protection, as can be seen in Figure 10, is constructed about ten years ago when the land reclamation was executed. Before the reclamation, there was a quite large coral reef area. The reclamation is partially constructed on this coral reef, because of the favourable bearing capacity. Now, ten years later, there is coral growing again. On the larger boulders of the rubble mound protection, small pieces of coral and sponges are visible. Also, several species of fish and sea urchin are found. Along the entire200 meter strip this life exists, but mostly in the partially sheltered area behind the breakwater (south of line A, Figure 9). This indicates that, although the changes in coastal profile, the marine life can adapt and re-grow. So even when creating a beach, after several years it is likely that the coral and fish do come back to the structure that has to be created.

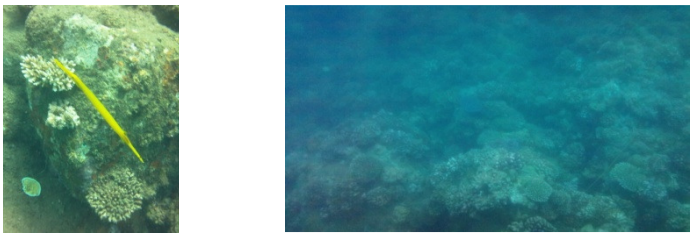


Figure 11: Marine fauna (l) and flora (r)

4.4 (Dis-) advantages

Examining the depth measures, the mild slope of the bottom and quite shallow area, the creation of the beach does not have to be a problem. The existing coastal protection is a safe protection against the ocean. This one has to remain for safety, but can partially be changed to create the beach.

One of the problems can be the marine life, now living at the bottom of the protection. The coral and habitat of the fish and crabs will be destroyed. However as mentioned previously, it seem to come back rather fast. This can be the case if a submerged breakwater is used at the seaside of the beach.

Figure 12: Possible alternatives for harbouring boats

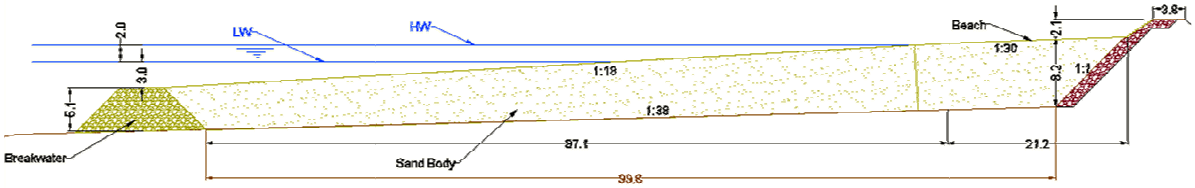
The jetty at the south side of the strip also can cause a problem. This jetty and the boats attached to it, will be requested to move when a beach will be created there. Nearby there are two other, sheltered, locations where it is possible to harbour the boats.

5 Design and Calculations

5.1 Global design

The design of the beach contains two main parts. One is a sand body and the second a submerged breakwater.

The beach will be created as a L-shape all along the coastal strip from the McDonald's in the north to The Club in the south. Behind the existing breakwater the beach will consist of a curved shoreline from the boulevard to the breakwater. The most narrow stretch of the beach will be at least 20 meters wide during high tide. Although in the corner near The Club it will be much wider, so it can be exploited by The Club with drinks and food.



Cross profile BB' with beach

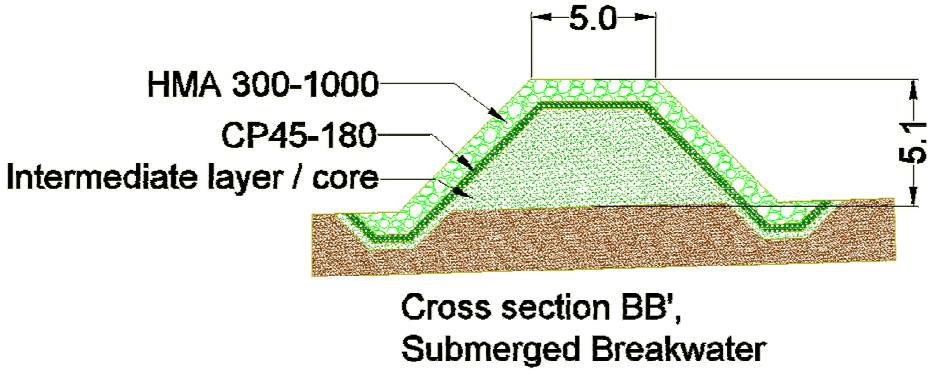
As can be seen in the cross section drawings, the beach will not reach up to the top level of the boulevard. This is because of the steepness of the slope. The existing rubble structures will partially remain to strengthen the upper part of the coastline during storm conditions. To reach the lower beach area (concrete/wooden) stairs have will be created over the rubble protection.

A problem concerning the creation of the beach will be, how to keep the sand at the shoreline. Because of the rather steep sloping bottom, about 200 meters of the shoreline and the natural tendency of a beach to have a very long toe in the equilibrium stage, a submerged breakwater will be constructed. This breakwater functions as a dam to prevent the sand from sliding to the lower parts of the bottom and to prevent the very long toe of the sand body. (impossible in this case because of the steep slope) Besides, in cases where a long toe would be possible, it can save a lot of sand. The submerged breakwater will be attached to the existing breakwater. The crest will be constructed about 5 meters below the high water line. By that, the breakwater always will be at least 3 meters below the water line at low tide.

The structure stretches from the tip of the existing breakwater about 175 meter parallel to the shoreline. To prevent the sand from sliding away sideways, the breakwater makes a turn in 'front' of the McDonald's / d'Terrace towards the shoreline and connects to the existing coastal protection.

Appendix 2: Volume Calculation

The beach' gives an extensive calculation of the dimensions and the filter construction of the breakwater. **Error! Reference source not found.** shows top view of the breakwater located in front of the McDonald's. (line B)



Cross section BB',
Submerged Breakwater

Materials needed for the breakwater:

Layer	Volume	Specific gravity	Needed mass (ton)
Intermediate layer	20.04m^2 * 284 = 5690m^3	2200kg/m^3	12518.00
Filter layer CP45/180	7.34m^2 * 284 = 2085m^3	2300kg/m^3	4795.50
Armour layer HMA 300-1000	34.66m^2 * 284 = 9845m^3	2650kg/m^3	26089.25

Table 2: Breakwater materials

The sand body will be created with nearby collected sand. In

Appendix 2: Volume Calculation

The beach' a calculation is made about the amount of sand that is needed to create this beach.

To prevent the beach from sliding down (even over the breakwater) a calculation is made about the minimal inclination of the beach
slope (

Appendix 3: Possible Inclination M-anado -BO-ulevard-B-each [M- BOB]). This calculation shows that with local circumstances, the minimal inclination of the beach has to be 1:9.8 or larger. In the final design, the slopes will have a maximum of 1:18, so according to this calculation the beach will be stable.

Next, the forces of the sand body onto the submerged breakwater are calculated. These are necessary to determine whether the breakwater will be heavy enough to withstand the mass of the sand body. The force of the sand is approximately 50kN/m1 on the slope of the breakwater. With a total mass of 1.528,26kN/m (152.826kg/m) and a friction coefficient of tan(32°)=0,7 the total friction force will be 1069.8kN/m. This means that in horizontal direction the breakwater is heavy enough to withstand the pressure of the sand body.
The largest remaining stability problem of the beach, is the impact of waves, and with that the cross shore transport of sediment over the submerged dam. According to the supplied wave data, there is not a very heavy wave attack, regarding this part of the coastline. The impact of the waves can assumed to be small. There always will be a loss of sediment, but that has to be resolved with regular nourishment (approximately every five years).

6 Method of execution

6.1 The sand body

A lot of nourishments in the world are done with the use sand. Most of the time the sand is gained from borrow areas somewhere at the open sea. The material is dredged by a Trailer Suction Hopper Dredger (TSHD), up to a depth of about 30 to even 50 meters. The borrow areas are specially selected, not to harm the ocean environment surrounding it. The way of transporting the sediment to the area where it will be used, can differ. Sometimes a floating pipeline is used, sometimes barges, but mainly the transport capacity of the TSHD itself is used because of the large sailing distances. The final unloading differs too, from one project to another. A few possibilities are rainbowing from the front of the ship, using a pipeline or opening the bottom doors. Around Manado there is a problem getting material in the way described above. First of all, a problem is the depth of the ocean surrounding North Sulawesi. Sometimes the depth is up to 1.5 kilometres. On average the ocean is deeper than 200 meter, already 1 kilometre away from the shoreline. This creates a very few places to borrow sand within sailing distance of Manado. Second, there is a lot of rocky bottom, and with that, not a lot of places with sand to dredge. In the north, between North Sulawesi, Talis and Banka there is an area with a depth possible to dredge. During the elaboration of this report, there is no study available about the soil conditions of this area. Whether there is usable sand or not. This has to be investigated before execution.

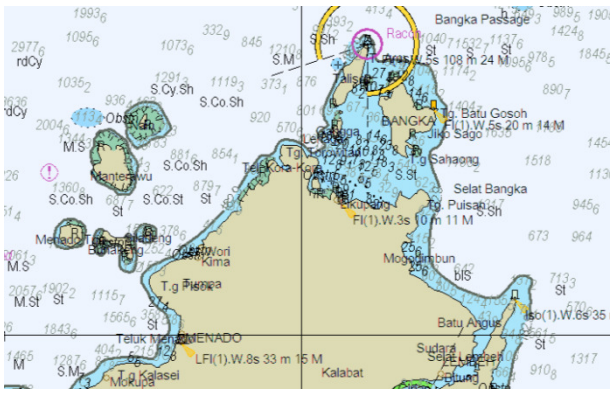


Figure 16: Depth chart North Sulawesi

In the north of Sulawesi, the Kora-Kora beach is created. For that, they used a borrow area at approximately 70km away. To create this beach, a sand type is used that is suitable for the Manado Beach too. So this area can be used as a borrow area for the sand body.

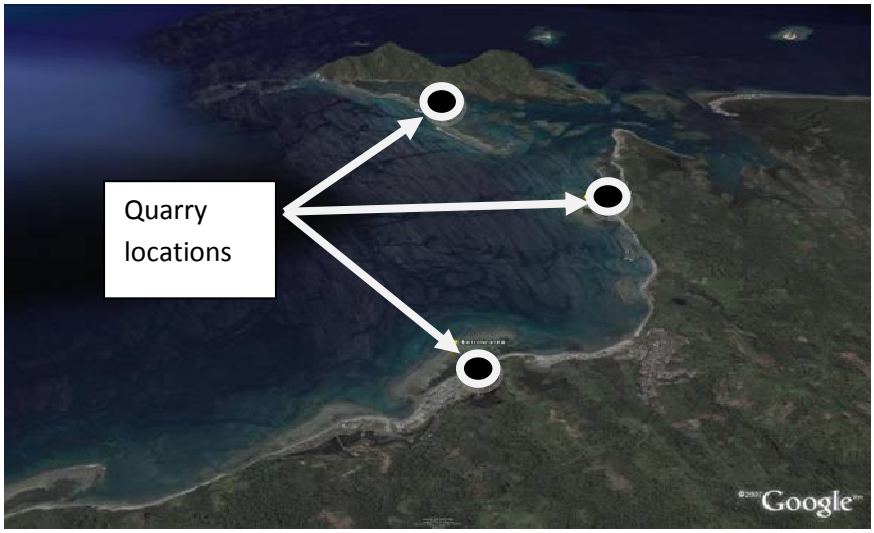


Figure 17: Borrow areas Kora-Kora Beach

Another possibility of getting sand, which will be used to construct the beach is from land. There are several quarries in the surroundings of Manado that, till present, supplied the material for the existing reclamation areas. This can possibly be used to partially create the beach. It might not be the most pleasant material to lie down on at the beach, but it can be used to create the lower part of the sand fill. For the top layer the material from the borrow area used for the Kora Kora beach can be used.

6.2 The Breakwater

The building of the breakwater happens separate and before the creation of the beach. First, by building the breakwater, a sheltered area has to be created before the filling with the sand can start. Therefore the breakwater is the first construction to be created.
The construction, as can be seen in the calculations later on in this report, consists of several layers. This is to prevent the dam to collapse or to slide away sideways.

The different stone sizes needed for the construction of these layers have to come from nearby stone quarries. In the vicinity of Manado there are multiple locations where rock is available. In the calculation is presumed that these quarries can supply standard rock grading.

The stones will be taken from the quarries to the building site by truck. At the site they will be stored and separated first. Later on they will be handled by both land and water based equipment because it is not possible to execute with only one of the two method. Both experience and equipment are available for the two methods.

ation near Manado (Tateli)

7 Environmental Impact

Along the Manado coast, there are multiple coral reefs and mangrove forests. Habitats that do support human life, are protected by an law of the Republic of Indonesia, Act No 5, 1990, about the Conservation of Natural Resources and Ecosystems. Several studies assume that dredging and dumping near places like sea meadows, coral reefs, mangroves, and tidal plains, may violate these rules. Rules that aim to protect the ecosystems that support human life and welfare, besides protecting the biodiversity in these ecosystems. Because of this, within further studies an Environmental Impact Assessment (EIA) has to be made to investigate the possible effects on the surrounding nature.

Near the Manado Beach location, there were and still are several coral reef areas. On the existing coastal protection already, new coral is growing and creating new habitat for the fish. With the creation of the beach this will be lost again, but it also gives the impression that also on the submerged breakwater new coral and fish habitat can grow.

Besides the direct effect of 'dumping' the sand onto the existing marine life, there is the effect of changing the coastal profile and with that the transport of sediment. Normally, regarding seasonality, beaches gather new sediment (sink) in one season, but lose it again (source) in another. In the case of the Manado beach, however, there will be a submerged breakwater. This means there is almost no new sediment flowing towards the beach area in the quiet seasons, while in the more heavy, rainy seasons there will be a loss of sediment because of the outflow of sediment in the offshore direction. This does not only mean that the beach is losing sand (and needs to be nourished again every few years) but that the sand is flowing into the coastal area around the beach. Because of the use of sand (rather large grain size), the sand will not be distributed along the complete coastline, but it is more likely that it flows to the deeper parts of the Manado Bay.

When creating the beach, with dredging as well as with dumping, fines will be moved with the sand. These fines tend to flow out of the dredged material into the open water. Because these fines are in suspension, they can be transported over a long distance by the coastal current, even in case of a minimal current. As a result, sedimentation and increased turbidity of water, which puts pressure on the entire reef system around Manado. The fines can choke the living coral all around Manado Bay. This is why, during execution, the concentration of fines in the surrounding area has to be kept at a minimal level.

Along the Manado shoreline there are a lot of Mangrove forests too. These trees are a very important ecosystem, mainly because of the habitat of marine fauna, protection against abrasion and filtering of silt from the rivers. The fines spreading out during the dredging processes are not a real threat to this system, but the possible change of the coastal current is a threat. Already there are several parts of the coastline that are continuously eroding, due to lack of mangrove trees combined with the change in current due to reclamation and the cutting down of the trees by humans. The second reason can be considered in the design phase of the Manado Beach. How to keep the effects of coastline changes on current patterns as low as possible?!

8 Advices

"The people of Manado are in need of new recreational facilities, preferably along the sea side. Taking that into account, there is nothing better and more relaxing as a beach."

By creating this beach a lot of people would be very pleased. Among them also the entrepreneurs in the surroundings of the possible beach. A further investigation into the willingness of participation of these stakeholders is needed, also for the financial feasibility of the project. If these businesses have the willingness to (financially) participate, the overall achievability of the project would be much higher.

When looking at the preliminary design of the technical elements of the beach, several aspects have to be elaborated extensively.

To protect the submerged breakwater an armour layer with a gradation of HMA300-1000 is used. The already existing emerged breakwater is covered with a combination of the same gradation and one larger (HMA 1000-3000). This is why the choice is made to use one gradation lower for the submerged beach berm.

To make a more detailed design, more information is needed about the coastal conditions near the breakwater. Most important are the wave condition at the position of the breakwater. More extensive measurements can provide the necessary data to create a detailed calculation.

In this study no calculation is made on the caving in of the beach due to wave attack. At the moment this report is written, no detailed data about the wave impact, currents and sediment transport at this part of the coastal zone is present. To gain a good impression of the reaction of the beach on several different, possible storm conditions a computational model has to be made. To do this, more data is needed than is available today.

For the technical part, the main focus should lay on the gathering of data in the coastal region of Manado city. With more specific data a better, detailed design can be made. A design for a beach that can make a lot of people very happy.

Appendix 1: Tidal and Depth calculations

The diving for the depth survey took place at 9.30 am. In combination with Table 1 the depth below the HW level can be calculated.

LW	HW	LW	HW
01:04	07:11	13:01	19:15
0.0 m	2.1 m	0.3 m	2.0 m

Table 3: Tidal data during measuring survey

- The depth change per minute: $\frac{(2,1-0,3)}{350} = 0,00514$;
- Depth change after HW: $0,00514 * 154 = 0,792m$;
- Water level during measuring: $2,1 - 0,792 = 1,308m + CD$;
- Depth below CD (m):

	A	B
1	6,5 – 1,308 = 5,19	6,5 – 1,308 = 5,19
2	7,5 – 1,308 = 6,19	7,5 – 1,308 = 6,19
3	7,0 – 1,308 = 5,69	9,0 – 1,308 = 7,69

Table 4: Depth below CD (m)

- Depth below HW (m):

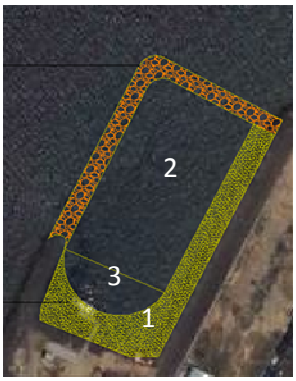
	A	B
1	5,19 + 2,1 = 7,29	5,19 + 2,1 = 7,29
2	6,19 + 2,1 = 8,29	6,19 + 2,1 = 8,29
3	5,69 + 2,1 = 7,79	7,69 + 2,1 = 9,79

Table 5: Depth below HW (m)

Appendix 2: Volume Calculation

The beach

To estimate the volume of sand needed for the creation of the beach, the sand body is separated into multiple parts. With the use of information gathered by the survey, a rough sketch of the area is made. In these sketches the design is implemented. Via measuring in these drawings the different areas and volumes could be estimated.



ure 19: Calculation regions

	Contribution	Area * Depth	Volume	
1	+	7436 *8	59.488	m3
	-	404*8*8*0.5	12.925	m3
	Subtotal		46.563	m3
2	+	169*555.72	93.917	m3
	Subtotal		93.917	m3
3	+	2619.7*10.1	26.459	m3
	-	2619.7*0.5*5	6.549	m3
	Subtotal		19.910	m3
Total Sand Volume			160.390	m3

Table 6: Sand body volume

Because this is just a preliminary calculation, 10% uncertainty is added which results in a total amount of sand needed for the beach of about 176000m^3.

The submerged breakwater

The average volume of the submerged breakwater, as designed in the rough sketch, will be approximately:

Cross section area (m^2)	Length(m)	Volume (m^3)
52	284	14.827

Table 7: Preliminary dimensions submerged breakwater

For the determination of the filter layers of the submerged breakwater the calculation is started with the known armour layer. To calculate the filter layers of this structure, the standard European classes of rock grading will be used, which is visualised in **Error! Reference source not found.**.

Standard classes of rock grading (EN 13383)

Class name	described in EN13383		D_{50} (cm)	D_{85}/D_{15}	D_{n50} (cm)	Layer thickness 1.5 D_{n50} (cm)	Minimal dumping quantity with layer of 1.5 D_{n50} (kg/m^2)
	range	range of M_{50} for category "A" (kg)					
CP45/125	45/125 mm	0.4-1.2	6.3-9.0	2.8	6.4	20	300
CP63/180	63/180 mm	1.2-3.1	9.0-12.5	2.8	9	20	300
CP90/250	90/250 mm	3.1-9.3	12.5-18	2.8	12.8	20	300
CP45/180	45/200 mm	0.4-1.2	6.3-9.0	4.0	6.4	20	300
CP90/180	90/180 mm	2.1-2.8	11-12	2.0	9.7	20	300
LMA 5-40	5-40 kg	10-20	18-23	1.7	17	25	500
LMA 10-60	10-60 kg	20-35	23-28	1.5	21	32	550
LMA 40-200	40-200 kg	80-120	37-42	1.5	34	52	850
LMA 60-300	60-300 kg	120-190	42-49	1.5	38	57	950
LMA 15-300	15-300 kg	45-135	30-44	2.7	31	46	700
HMA 300-1000	300-1000 kg	450-690	65-75	1.4	59	88	1325
HMA 1000-3000	1-3 ton	1700-2100	103-110	1.4	90	135	2050
HMA 3000-6000	3-6 ton	4200-4800	138-144	1.2	118	177	2700
HMA 6000-10000	6-10 ton	7500-8500	167-174	1.2	144	216	3250

Before calculating the filter layers, first the type of filter has to be determined. Two options are available, a geometrically open filter and a geometrically closed filter layer. The risk of geometrically open filters is that sediment can flow out, though it is 'controlled'. With a strong current along the shore, there is a risk of failing. Besides, because of the unavailability of the data about shear velocity between the different layers, in this preliminary study, it is not possible to review the possibility of an open filter layer.

Now the filter rules for closed filters can be applied:

- Stability: $\frac{d_{15F}}{d_{85B}} < 5$
- Int. Stability: $\frac{d_{60}}{d_{10}} < 10$
- Permeability: $\frac{d_{15F}}{d_{15B}} > 5$

For the determination of a base layer when the filter layer is already known the stability and permeability rules can be written as: $\frac{d_{15F}}{5} < d_{85B}$(stability) and $\frac{d_{15F}}{5} > d_{15B}$(permeability).

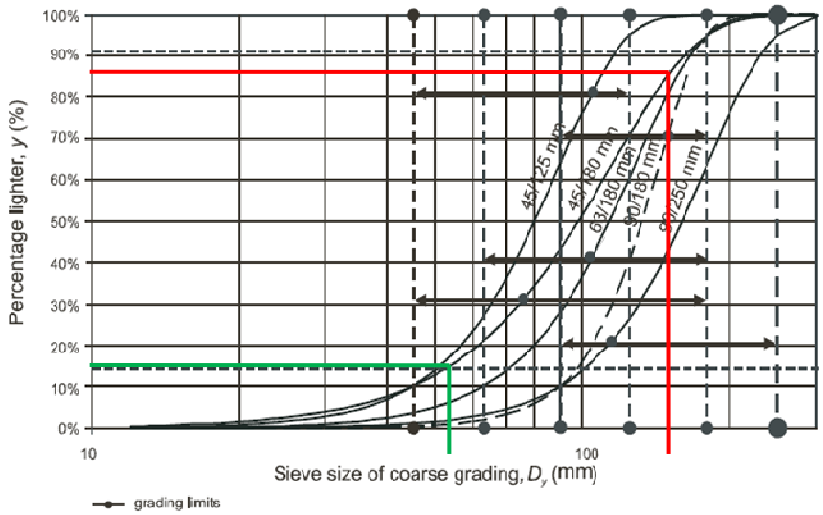


Figure 21: Sieve curve course grading

The used armour layer will consist of the same rock type as the already present emerged breakwater. This rock has an estimated grading of 300-1000 (some stones are even 1000-3000) according to the surveys. This results in the standard grading class of HMA 300-1000 according to the EN 13383. By knowing this the underlying filter layers can be determined. From the Dn-distribution, in Figure 22, the D_{50}=700mm, D_{15}=650mm and D_{85}=780mm can be obtained.

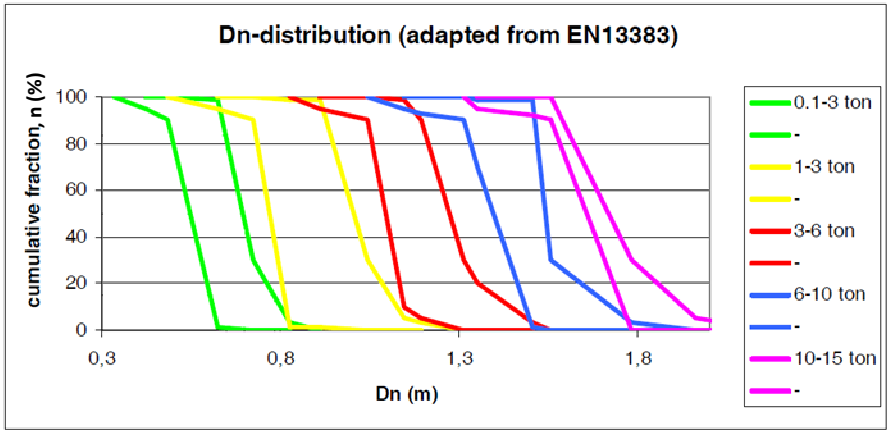


Figure 22: Dn distribution heavy material

So for the first base layer (layer under armour layer): $d_{85B} > \frac{d_{15F}}{5} = \frac{350}{5}$=130mm and $d_{15B} < \frac{d_{15F}}{5}$=130mm. To find a suitable stone class the sieve size graph of Figure 21 is used. **CP45/180** fulfils the requirements of the closed filter rules. Even $\frac{d_{60}}{d_{10}} < 10$ is valid, because $\frac{110}{45} < 10$.

From this layer, the next base layer can be determined. The CP45-180 material gives d_{15} = 53mm and d_{85} = 160mm. Applying the closed filter rules, it is obtained that: $d_{85B} > \frac{d_{15F}}{5} = \frac{53}{5}$ =10.6mm and $d_{15B} < \frac{d_{15F}}{5}$ = 10.6mm.

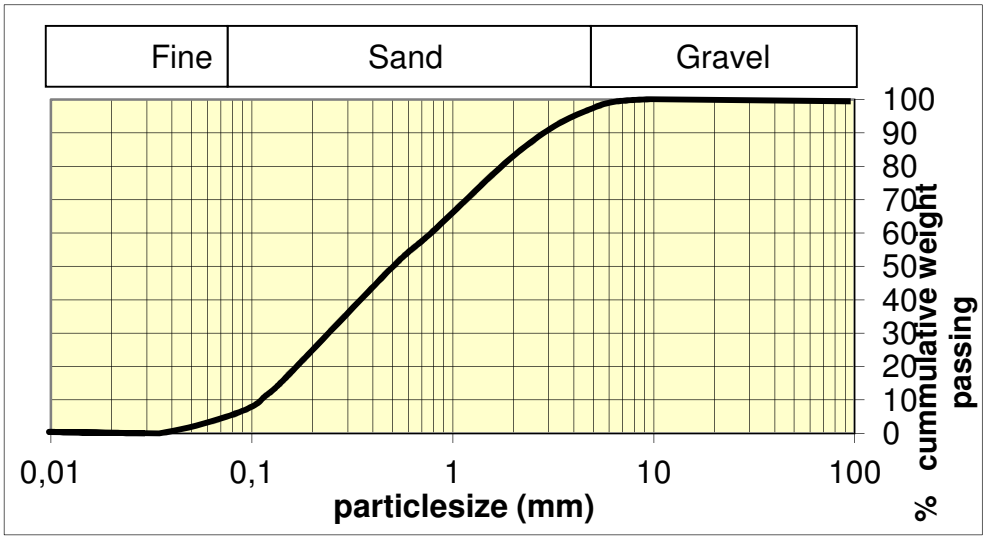


Figure 23: Sieve curve D_{50}=0.5mm

To determine the next layer, which isn't a standard rock class, it is wise to examine the seabed soil first. The soil properties are: d_{10} = 0.11mm, d_{15} = 0.15mm, d_{50} = 0.5mm, d_{60} = 0.8mm, d_{85} = 2.3mm.

By applying the closed filter again:

- The seabed as base layer:
  - d_{15F}<5*d_{85B} → 5 * 2.3mm > d_{15F} → d_{15F} < 11.5 mm
  - d_{15F}>5*d_{15B} → 5 * 0.15mm > d_{15F} → d_{15F} >0.75 mm
  - $\frac{d_{60}}{d_{10}} < 10$ → $\frac{0.8}{0.11} < 10$

- CP45/180 as filter layer:
  - $\frac{d_{15F}}{5} < d_{85B}$ → 1/5 * 53 < d_{85B} → d_{85B} > 10.6mm
  - $\frac{d_{15F}}{5} > d_{15B}$ → 1/5 * 53mm > d_{15B} → d_{15B} < 10.6mm
  - $\frac{d_{60}}{d_{10}} < 10$ → $\frac{85}{45} < 10$

To create a smooth transition between the seabed and the first filter layer. The d_{15} of the intermediate layer has to be smaller than 10.6mm, but larger than 0.75mm. The d_{85} needs to be larger than 10.6mm. This leads to the use of a stone class with a wider gradation than the standard: d_{15} = 2mm, d_{50} = 12mm and d_{85} = 25mm.

The breakwater will, according to the calculations will exist of the following layers:

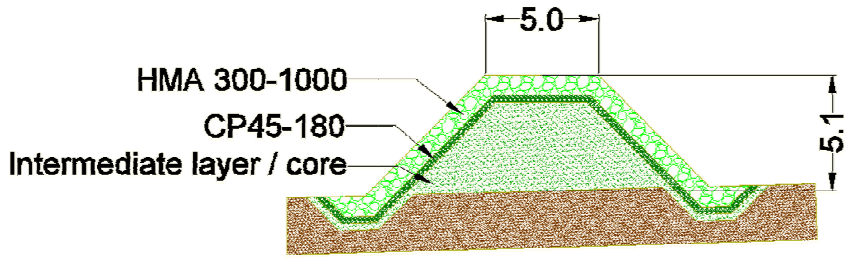
* Original seabed; d_{15} = 0.15mm, d_{50} = 0.5mm, d_{85} = 2.3mm
* Intermediate layer; d_{15} = 2mm, d_{50} = 12mm and d_{85} = 25mm
* Filter layer CP45/180; d_{15} = 53mm, d_{50} = 73.5mm and d_{85} = 160mm
* Armour layer HMA 300-1000; d_{50} = 700mm

Each layer has it's minimal thickness:

* Intermediate layer; 300mm, construction based.
* Filter layer CP45/180; 300mm, construction based.
* Armour layer HMA 300-1000; 900mm, EN 13383 based.

Needed material:

* Intermediate layer; 20.04m^2 * 284 = 5690m^3
* Filter layer CP45/180; 7.34m^2 * 284 = 2085m^3
* Armour layer HMA 300-1000; 34.66m^2 * 284 = 9845m^3



Cross section BB',
Submerged Breakwater

Appendix 3: Possible Inclination M-anado -BO-ulevard-B-each [M- BOB]

Infinite slope;

For $F > 1$ the slope is stable and for $F \leq 1$ the slope is unstable.

Dry and wet (still water, not realistic)

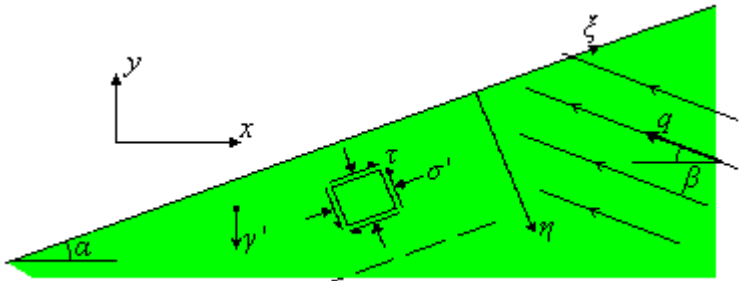
$$F = \frac{\tan\phi}{\tan\alpha}$$

Perpendicular (without top load)

$$F = \frac{\gamma - \gamma_w}{\gamma} \frac{\tan\phi}{\tan\alpha}$$

Horizontal flow

$$F = \frac{\gamma - \frac{\gamma_w}{\cos^2\alpha}}{\gamma} \frac{\tan\phi}{\tan\alpha}$$



Outflow from various directions;

$$F = \frac{\tan(\varphi)}{\tan(\alpha)}\left[1 - \frac{\gamma_w}{\gamma'}\left(\tan(\alpha)\tan(\alpha+\beta)\right)\right.$$

Parameters: c=0

$\gamma_{sand;w}$= 20 kN/m^3= 2.0 t/m^3 $\gamma_{sand;d}$= 18 kN/m^3= 1.8 t/m^3

ϕ= 35^o [Medium Dense Sand] → ϕ= 32^o [Loose]

$\gamma_{seaw.}$= 10.25 kN/m^3

α= ? for F= 3.0

$$F < 0.5 \cdot \frac{\tan\phi}{\tan\alpha} \rightarrow \tan\alpha < 0.5 \cdot \frac{\tan\phi}{F} \rightarrow$$

ϕ= 32^o → α< 6.66^o= ± *1: 8.56*

ϕ= 32^o → α<5.95^o= ± *1:9.6*

F=? for α= 1:5

$$F = \frac{\gamma - \frac{\gamma_w}{\cos^2\alpha}}{\gamma} \frac{\tan\phi}{\tan\alpha} \rightarrow \quad F = \frac{20 - \frac{10.25}{\cos^2 11.31°}}{20} \frac{\tan 35°}{\tan 11.31°} \rightarrow$$

F=1.635

ϕ= 32^o → F= 1.45

F=? for α= 1:6

$$F = \frac{\gamma - \frac{\gamma_w}{\cos^2\alpha}}{\gamma} \frac{\tan\phi}{\tan\alpha} \rightarrow \quad F = \frac{20 - \frac{10.25}{\cos^2 9.46°}}{20} \frac{\tan 35°}{\tan 9.46°} \rightarrow$$

F=1.99

ϕ= 32^o → F= 1.77

Appendix 4: Internal forces on toe construction

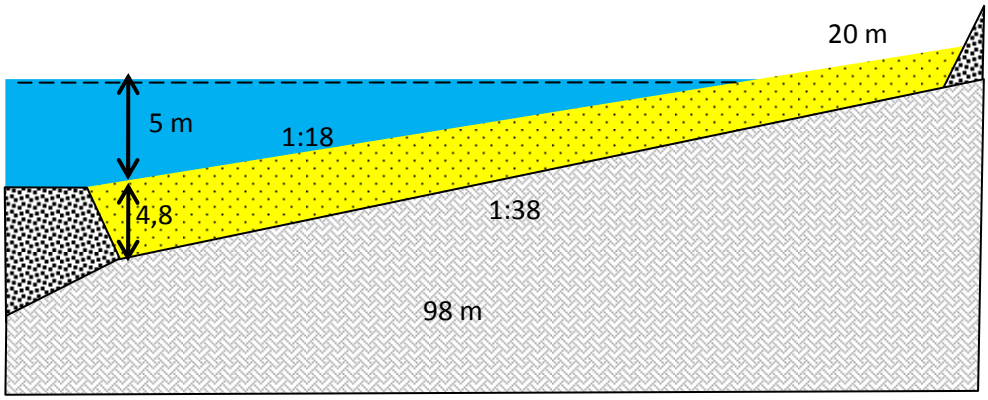


Figure 26: Calculation impression of the design

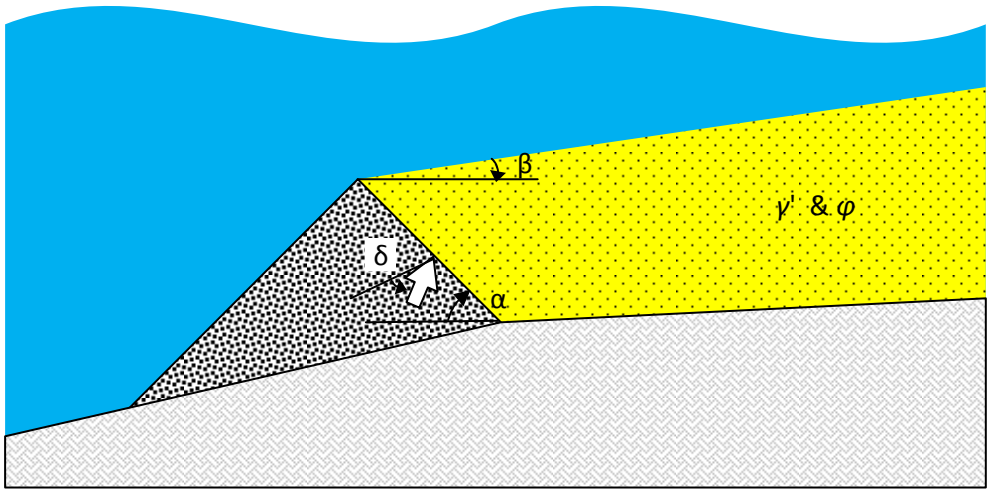


Figure 27: Calculation impression for the toe construction

$\varphi = 32^{o}$ [Loose]

$\gamma_{seaw.} = 10.25\ kN/m^3$

$\alpha = 45^{o}$ $\beta = 1{:}18 \approx 3.18^{o}$ $\delta = {}^{1}/_{3}\,\varphi$

$$Q'_{res} = \tfrac{1}{2} K_a \gamma' h^2$$

$$K_a = \frac{\sin^2(\alpha+\varphi)}{\sin^2\alpha \cdot \sin(\alpha-\delta)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\sin(\alpha-\delta)\sin(\alpha+\beta)}}\right]^2}$$

$$= 0.7816$$

$$Q'_{res} = 87.8 kN/m^1$$

$$Q'_{res;h} = Q'_{res} \sin(\alpha-\delta) = 49.5 kN/m^1$$

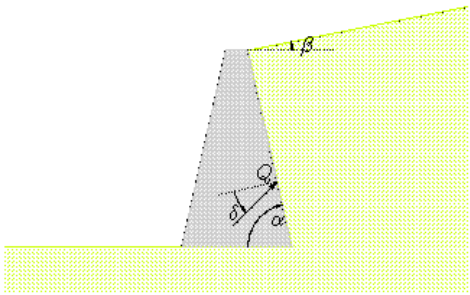


Figure 28: Angles soil retaining dam

Appendix J
Garbage Plan

Contents

List of figures

1 Introduction

Worldwide garbage is threatening to engulf cities and endanger the way of living known to those who live there. Especially the cities developing rapidly because of new found industries and improved governmental management are vulnerable to this kind of threat. If one wishes to not run aground during this development the problem of garbage has to be tackled.

The way of living is not always just a given thing, in most cases people are known for their ability to adapt to changing situations. This does not always turn out to be for the good, in the case of Manado people adapted to the growing pile of garbage by finding fast and easy – for them – solutions of getting rid of it. In most cases nature is left with the largest share of the load. In this way the life altering consequences will not be felt at first, but must be faced in a later stage.

Next to this the importance of a clean city can have a positive effect on the general hygiene. Water in the city will not be so polluted anymore because less trash washes out into the rivers. Also the problem of pests like cockroaches and rats will decrease. These animals, especially cockroaches are attracted to places that are dirty and are littered with “food” for them.

In this case for example the garbage at this moment is also doing irreversible damage to the coral reef and the eco system in general. In this way the standard of living will not improve. Humans need room to enjoy and feel one with nature in some point in time, one way to do this is to have a nice and clean environment. This report hopes to point out some of the problems and also show some possible solutions from several angles.

2 The need for a Garbage plan

The way garbage lays on the street and floats in the moats and rivers in Manado is not healthy for its surroundings. The need to change this garbage littering the city is very urgent. The way rodents and pests are spreading throughout the garbage is alarming for general hygienic and the living situation of people.

In the general sense the garbage is destroying live as the city inhabitants use to know it. Because of the growing population and the increasing prosperity the use of and production of plastics and other non-organic materials is growing rapidly. The average time to naturally dissolve a plastic bag is between 50 years and 150 years. The rate at which garbage is produced is about hundreds of thousands times faster than the rate nature can process it. This will have an avalanching effect on the accumulation of garbage in the environment.

The City of Manado is such a place where lots of garbage is produced and is introduced in nature without intervention of 3R (**r**ecycle-**r**euse-**r**educe) measures. Measures have to be taken to improve the situation. This can have a lot of variations to it. The main goal however is to reduce the garbage in nature by recycling and reusing the collected materials. Plastic especially is an material that easily lets itself be reused by recycling without adding much more new raw materials making it less pressing on natural resources.

The general population is very concerned with their city, people who know how the city was before the large population growth and prosperity tell about a place that had a lot of beauty and that garbage was no issue in the city at all. The goal is to give the current generation back what people talk about when telling about a Manado of the past.

3 Short Definition of the Problem

The main problem will be evident; The Large production and accumulation of garbage in Manado city. This a very generalized and will not cut the full extent of the problem. The consequences also differ a lot. One can have troubles with the environment, but also some indirect consequences can be clogging of drainage system, having flood problems, bad smells in the city, large scale pests infestations etc. All because of the bad handling and management of garbage.

The problem can be divided into several categories, knowing:

- Garbage on the Streets;
- Garbage in the Rivers;
- Garbage handling.

On the basis of these three points the rest of the plans will be discussed and solution will be suggested.

3.1 Garbage on the Streets

The first point that will be discussed is garbage on the street. In the past before the population started to grow there was no problem with garbage. Households and Industries did not use much plastics and if they did they used it more than once. A lot of the materials used then came straight out of nature, with or without finishing.

Nowadays a lot of products are bought in supermarkets and packages have a one-time-use only. This causes most of the garbage. Garbage coming in the environment 9 out of 10 times is the fault of people, or better said the ease of it just throwing it on the street instead of disposing it properly in the places intended for that purpose. If at least there is any!

The problem is that this uncollected garbage will not be collected and will accumulate in places (transported by rain or wind or just swept into a corner). An example of these is given in the following figure:

Figure 1: Outwash of garbage by rain

This is just one of the many examples that can be found on waste that is in full view on the street and are a nuisance for the inhabitants of Manado city.

With this there are more problems in the city that contribute to this becoming a problem. First the distribution and availability of garbage collection points. In quiet a lot of cases the state of these is very poor. Second the collection is done with garbage trucks, the thoroughness of this can be very much doubted so lots of garbage is left still on the scene.

Also the workforce behind garbage collection isn't that strong. Largest part of the time this causes the lack of a efficient collecting of Garbage. This is party an effect and a cause to the above given problem definitions.

3.2 Garbage in the Rivers

The following piece in the problem description is on garbage that is collected in the river. The rivers of Manado are very polluted because garbage is dumped directly or indirectly into the system (example is the washout of garbage thru the sewage system). This leads to local garbage problems, but also garbage that finds its way to the ocean cause lots of debris washing up on the shores of neighbouring Islands.

Figure 2: Trash on the shores of Siladen Island (15 km from Manado)

Garbage in the drainage system cause several things to happen. Foremost is blocking the system flow through. With the system in Manado already being under capacitated for the current rainfall situations the problem of blocking cause the system to overload even more quickly. Next to this the quality of the water will be endangered because the plastics and other litter will secrete certain chemical- and organic compounds that are very harmful for the environment.

In the process of getting the rivers clean again there are several steps to be taken. First u have to remove the existing garbage from where it is, by which means are discussed later on. Second is preventing the garbage from entering the system again. In this last matter a great societal change has to be forced upon the people.

Beneath some examples are shown of garbage in the river and also some channels are depicted:

Figure 3: Trash in a River mouth

The figure show the severity of the trash in the river and together with the outwash towards sea it really has to be put to a halt.

3.3 Garbage handling

The last point addressed in the plan is the handling of garbage. The investigation into the topic learned one that the city is working on how to handle and process the large amount of garbage. Several options are made clear and some are still in the idea phase. The handling of garbage is just as important as the rest of the steps described in the above paragraphs.

After the trash is collected it goes to a collecting point from where it is transported to a belt or to the harbour were it is taken to places where they have better (read: more) facilities to process the garbage. Efficient and complete process facility closer to Manado will improve the quality of the disposal and handling of trash. Next to basic processing as for example incinerating the trash. On the streets this is donein small amounts, the big disadvantage her is that the trash is just transformed to ash and still is littering the streets. Let alone the stance that is spread by burning the trash.

The problem here in Manado is that it has not enough facilities for handling garbage. This applies to both the small parts as sufficient bins and collection points as to large parts such as processing factories/plants.

3.4 MISI (Mission)

Part of the city's policy are the VISI&MISI goals. The first one has to do with the goal of becoming an city for eco-friendly tourism. The second one is much more in the line of the garbage plan. The second goal states that the city has to become a place with happy and satisfied people and that a lot of problems as for example garbage must be solved.

The reason why this matter is addressed here party is because the problem of garbage is not new to the city, even campaigns and elections are won because of people needing solutions for the problem. This makes it important to make progress starting immediately and felt directly by the inhabitants. The wanted short term action will be considered within the possible solution section.

This MISI is not mend as a plan for concrete solutions. Within the total solution package some abstract solutions will be addressed, for example to change the mindset of people, trying to change the habit of just throwing it on the street. By given it a little more attention and trying to throw it in the proposed disposal places the MISI plans can become much more effective.

4 Possible Solutions

The possible solutions in this garbage plan will be a mix of concrete solutions (read: “ready to use”) and abstract solutions. Possible means not that these are the solutions that must be adapted in practice but it should be considered as fuel for getting to a solution that is designed completely and has been thru the governmental organs that make decisions on this matter.

The next solutions are a selection of all the ideas that were found in brainstorm sessions. The best, most probable and interesting solutions are given below.

4.1 Human mindset

The garbage problem is experienced by probably all people in Manado. In a way also the problem starts with these same people. The way they handle garbage is not correct, many just dump it on the street and by making it somebody else’s problem by definition it will not be their problem anymore. The way this mindset was ever adopted by people is not clear. Several causes point towards human behaviour and others point toward culture. The real cause of it is beyond the scope of the project and must be accessed by people specialized in this matter. The one thing clear is that it has to change because without people undertaken action themselves, other solutions are doomed to fail.

In the case of Manado there plenty examples of garbage on the street and in the rivers. To make people more aware changes must be forced upon them. First people should be educated in the basic garbage problems, what they cause and how to treat them properly by throwing them in the purposed places on the street. One can start education from elementary school and work up towards the town hall people by campaigns or advisors that travel around the city to explain how to treat garbage. Also people must correct others that will not follow or are not aware of the guidelines concerning the handling of garbage.

The idea is that by a domino effect everybody will eventually become aware of handling garbage in a proper way. Garbage will be part of the human mindset and their culture. By accomplishing this the other steps taken to decrease the garbage problem will also be more effective because people in fact are aware of the dangers of garbage and see more sense in taking measures against them.

4.2 Eco Friendly in Products

In the current packing industry a lot of the products are packed in packaging that for the largest part are made of plastics or composites. For the materials to dissolve in nature it can take up to 150 years or more for certain kinds of plastics.

An idea here is to look at more ecological packing materials. Such as paper or bio degradable plastics made of corn starch. Because these materials in comparison to the traditional plastics are very expensive and are not attractive for the way plastics are packed now. First one must take action against all the unnecessary packing material, packing-in-packages and one-use packages for example sachets of shampoo and water cups.

Figure 4: Campaign picture of the 3R's Recycle

Shops and supermarkets are not always left a choice in the products they offer, but in a lot of cases the same product is packed in several size packages. By selecting –by stakeout or experience – the most used package size, keeping in mind that people may buy several small packages where they can also buy one bigger package. In this way reduction is brought about on the packaging/product ratio.

Last solution in terms of products is the level of recycling that has to be upgraded, lots of the plastics used are of the thermoplastic type. This type of plastic can be remoulded by using heat into any given shape. By collecting plastics separately from the rest recycling can be more easily done and can be processed directly without much pollutants (read: other materials) into plastic pellets that on their own can be reused to form new plastic products.

4.3 Promote/Reward Supermarkets for taking Eco Friendly Initiative

Another solution is to make a rewarding system for supermarkets (or the larger shops) if they introduce eco friendly initiatives in their business. Shops must not only be forced to make changes in their assortment, because this can go either way, but also need to be stimulated. This can be done in terms of money funds by the government or also by means of stimulants in kind. This can be for example promotional use of their products during events and extra advertising of their products in eco campaigns.

Figure 5: One of the many eco friendly trademarks

A good example might be the reduction of plastic bags that are given to costumers. Instead of this it they should be replaced by paper bags or reusable and more robust linen bags. And allow them to wear a marker of eco friendliness. A small note must thus be made, people need to understand the meaning of this branding and also must value it in terms of positive contribution to preserving the environment.

4.4 Trash in the river, River trash bin

Trash in the river makes the problem not only local but by transport to sea garbage can also end up on the neighbouring shores of Island or worse in the open ocean ("Plastic Soup"). The river trash bin idea is set to have two levels. The idea of flushing garbage away by the river must not be a permanent solution because eventually the rivers must be free of garbage and fit in a healthy eco system. To collect the flushed garbage for a certain period of time it is advisable to catch them at the end of the line where the garbage will end up, in this case the river mouths. Structures to do this have to be engineered rugged but not to last more than 20 years. In this period hopefully a solution is found to prevent garbage from ever entering the river.

Figure 6: Garbage catch structure

The catching only concentrates on the primary drain channels/rivers. The Secondary drain channels are assumed to be adequate to transport the trash from second to prime level drain channels. The tertiary channels that consist of small channels can easily clog and are not suited for this purpose. They must be cleaned and kept free by other means. A better occupancy of trash bins in area where lot of these tertiary channels are found can prevent them from clogging up.

4.5 "Show" Garbage

Showing garbage is all dedicated to making the people aware of the garbage services in the City. Because of the kind of job workers in this sector most of the time are not well educated and thus probably not dwelled on when walking thru the city. In fact they are probably the most important men in this city. Working with garbage is no easy job and certainly not the best paid.

While working as garbage men they are disregarded by a lot of people, they will not turn their heads and notice them working in the city. In this way they also will miss the stimulant to take out the garbage or keep in mind to dump the empty plastic bottle in their hands in the trash bin that is 12 meters away instead of just throwing it in the gutter they just walked by. A lot of this refers to the first paragraph on the human mind set.

A way to change this is to make the garbage men, and notice them being there. By putting them on a bright shirt or by putting large signs with slogans on their trucks or whatever vehicle used to transport trash. A slogan example could be “We keep your future clean”. Many of these kind of ideas can be put forward. As long as they “show” the garbage men working to help solve the garbage problem.

Figure 7: Campaign of Van Gansewinkel, a Dutch garbage company

Van Gansewinkel is a known Dutch company that is specialized in the processing of garbage and collecting it. Their slogan reads “Afval bestaat niet” meaning “Garbage does not exist” with this they try to promote their recycle and sustainability policy. In Manado this is not appropriate but it probably is a good point to start the thinking if something like this is going to be introduced.

A good example of recognizable vehicles in the city of Manado are the Microlets. These are small light blue busses that can drive your around the city like a taxi service. Everybody recognizes these, so it is easy to see the difference between the general traffic and the Microlets.

Figure 8: Mikrolets in Manado

5 Conclusion

The Garbage Plan is a short report consisting of a brief introduction to the garbage problem from where we directly go into the general remarks and problems in the city of Manado. The problem in Manado can be described as being very urgent. Changes are really necessary to improve the ecological value and hygiene before the situation reaches a point of no return.

The solutions are both concrete and abstract. The concrete solutions are things that could be done in a short time span and will already have a plan on how to exactly fill in the problem. The abstract ideas are the ones where a goal is given without a real solution. This is done because some of the facts about the subject are not completely understood and need investigation beyond the scope of this short garbage plan.

The biggest and most important thing that has to change is the mindset of people. Concerning garbage the mindset in its current state the other plans, also the ones made within the government will not work or have very little effect. The foremost goal here has to be changing the mindset of people that garbage has to be cleaned up with the help of society. Or all other plans and projects will never reach their full potential.

6 Recommendations & Advice

The plan has produced some advices and recommendations on the problem of garbage in the city of Manado. In the following the main points will be addressed so as one reads these can understand what one needs to be doing or try to do.

The points are the following, knowing:

- Before others plan will be executed a great deal of effort must be done to make people's mindset become in line with the need for improvement in garbage control in the city. Without the people's help all other solutions will fail or don't have their maximum potential.
- Garbage men and the men working on the street cleaning the street must become more part of society. Examples of doing this is by creating an campaign in which the garbage men and material become more visible on the street. Hopefully stimulating people to take their trash out on the street in the bins from where garbage service can pick it up and process it.
- Improve the products and their packaging to reduce their package/product ratio (reduce the packing material for products by using larger quantity product in combination with optimal packaging).
- To save raw materials as fossil oil and other natural sources one should look at the possibilities of reusing/recycling materials. Plastics is one of the best examples because lots of it is used in the packing industry. Other materials that are suitable for recycling are glass and metals (soda cans and larger part of aluminium)

These are the points that can be traced back to the main plan. These points are just some of the possibilities of potentially cleaning up the city. For every problem there has to be a foundation on which the total problem can become a solved on

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