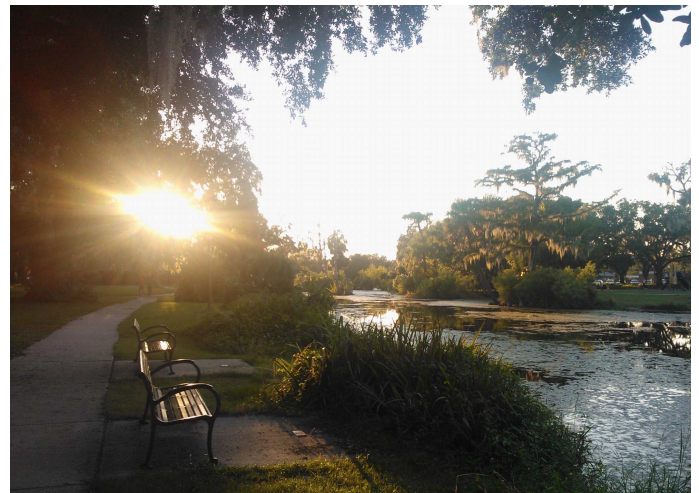




IMPLEMENTATION OF THE GREATER NEW ORLEANS URBAN WATER PLAN: IDENTIFYING AND OVERCOMING SOCIO-INSTITUTIONAL CONSTRAINTS



MSc Thesis
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21-03-2014
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Implementation of the Greater New Orleans Urban Water Plan

Identifying and Overcoming Socio-Institutional Constraints

By

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in partial fulfilment of the requirements for the degree of

Master of Science

in Civil Engineering

at the Delft University of Technology,

to be defended publicly on Friday March 21, 2014 at 14:00.

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I Abstract

The Greater New Orleans area suffers from flooding caused by extreme rainfall events on a yearly basis. Since most stormwater is flushed into the drainage system via mostly impervious surface, water does not infiltrate into the ground, which causes subsidence due to soil drying out, which causes damages to roads, buildings and underground utilities. These problems are now being addressed in a comprehensive plan called the Greater New Orleans Urban Water Plan (UWP). The project area consists of the east banks of Orleans and Jefferson Parish and all of St. Bernard Parish. The goals of the UWP are to increase safety, provide economic opportunity, and improve quality of life.

The next step is implementation. In literature several constraints are found towards implementation which are usually more socio-institutional rather than technical, such as unclear, fragmented roles and responsibilities of local government and limits of regulatory framework. A study was conducted to identify the next steps for implementation. The framework in which this was done consists of a stakeholder analysis, followed by interviews which gave input for a Strengths-Weaknesses-Opportunities-Threats-analysis (SWOT-analysis), identified constraints towards implementation and gave input for a Multi Criteria Decision Analysis (MCDA).

The SWOT analysis showed more strengths and opportunities than weaknesses and threats, which shows that overall the interviewed stakeholders are positive about the plan. The biggest strengths of the UWP are considered the approach and principals, the biggest weaknesses is funding and lack of technical data in the plan, the biggest opportunities are in funding and cost savings and the biggest threats are costs, creating enormous expectations for organizations, the potential of mosquito breeding sites and it being too much work for an organization. The weaknesses and threats need to be considered in order to start implementation.

The constraints that were identified were put in the framework of the chain model. The chain model is a tool which was developed by a workgroup of the Dutch Ministry of Public Works to develop a new way of policy making, since this policy subjects were becoming more and more complex. The model consists of five elements: policy, legislation, implementation, maintenance and control, and organization. Basically, what the policymakers decide in the first component influences the work of all the stakeholders in the next components. The idea is that different stakeholders from each of these components should be involved from the very beginning to help state what the policy issues are and what causes them. This could require changes to the last component, organization.

After identification of the constraints by the stakeholders during the interviews, it became clear that a component was missing from the chain model, namely politics. Since the UWP was not developed by local government, the first step is for local elected officials to buy-in. In each of the components of the chain model constraints were identified. In politics the most mentioned constraint is getting buy-in from general public, which would require a lot of outreach according to the interviewees. A small survey was conducted which revealed that general public had knowledge on the stormwater management and subsidence, but hardly anyone knew about the UWP. Yet, when explaining the principles and strategies of the UWP to them, the overall reaction was quite positive, showing that this is a constraint that might not be that difficult to overcome. In the field of policy and legislation the biggest constraint is the lack of policy and legislation. All three parishes have a comprehensive plan that shows the vision and policy for the future. In Orleans and St. Bernard Parish these plans

include a vision that is similar to the UWP. As for legislation, there is hardly anything that incentivizes projects and plans of the UWP. But there are some developments on the way; Orleans Parish is in the process of rewriting their Comprehensive Zoning Ordinance, which now includes an article on stormwater retention in new developments and re-developments and Jefferson Parish is conducting a study towards the reduction of the amount of needed parking lots for new developments, but more can be done and should be done in for example ordinances on roads and building codes. Constraints in implementation can mostly be accounted to not knowing enough about the UWP. The constraints focused on project areas being in areas which are too densely developed, however the UWP does not contain any projects which require buildings and developments to be torn down, or projects being on private land, which is only the case when this is in agreement with the owners of the private land. The biggest constraint with maintenance and control was the possible lack of maintenance, and more importantly, the responsibility of maintenance, which in some cases still needs to be assigned to an entity, organization or person. The component organization had multiple constraints that were frequently mentioned: responsibility of different aspects of the UWP; fragmentation on a local and regional level; coordination; and cooperation and agreement between entities and parishes. These are very important constraints to overcome, since in order to reach the full potential of the Plan it should a regional effort. Funding and paradigm shift where the most frequent mentioned constraints, which can be placed in multiple parts of the chain model, funding in implementation and maintenance and control, and paradigm shift in politics and organization.

The ELECTRE III method was used to perform an MCDA for several elements of the UWP on several criteria and the most frequent mentioned constraints. It revealed that there is a difference in what is best to implement, based on the criteria, and what is easiest to implement, based on the constraints. It also showed that it might be rewarding to take a different approach in what to implement in each parish, since the outranking results were different for each parish.

In an ideal situation for implementation of the UWP a regional entity would be created which would have responsibility of urban drainage and subsidence in the whole project area. Since this will be difficult to realize, due to entities needing to give up responsibilities and the fact that an extra entity will be added to an already complex organizational structure it might be better to create a board in which each of the entities and parishes participate. Also, currently the most general approach for implementation is a top-down approach, however, since the neighborhoods in the region, especially in Orleans Parish are quite strong, a bottom-up approach should also be considered. However, it should be taken into account that this will only be a good approach for small-scale retrofits, and not for the large scale strategies in the UWP, such as circulation of the canals.

Implementation of the UWP will be a big challenge and making additions to the plan, like an action plan for the stakeholders or adding more scientific background, will not be enough, but there are a lot of steps that can be taken. Assigning responsibilities, maybe even changing the jurisdictions of some entities, making policies and legislation that incentivize implementation of the Plan and enforcing this legislation, finding a way to get every stakeholder around the table, which perhaps can be done in the form a board. Communication will be a very important aspect, in the form of outreach to the general public, but also to remove some of the uncertainties that stakeholders have. And finally commitment is needed from local government, commitment by adjusting policies and regulations, but for now starting to implement the proposed demonstration projects.

II Preface

This master thesis is the result of ten months of research to complete my master at the TU Delft. Ten months in which I was allowed to research the field of implementation and the constraints that come with it. A field of research that I was not familiar with, but found very important to learn about. During my time at the TU Delft, completing my bachelor civil engineering and following the courses of the master water management I learned a lot about designing and modeling typical civil engineering and water management projects. Yet, not a lot of attention is given to what happens once that is done. Working on this topic gave me the opportunity to see it from the implementation side, which I found very interesting. It also gave me the opportunity to do field research in New Orleans, a city I would recommend everybody to visit once in your lifetime!

In these ten months (and years before that) I met a lot of people and received a lot of help. Therefore I would like take this opportunity to thank them;

First, I would like to thank my graduation committee, Frans van de Ven, Jos Timmermans and Nick van de Giesen, thank you for your guidance and support throughout my thesis. Your interest and expertise in various areas helped me very much!

I would also want to thank the people I met in New Orleans. First of all Mark Davis, for finding me a work spot at Tulane University, but mostly for your enthusiasm and help conducting my field research. Maria Papacharalambous and David Waggoner for your help and providing me with the necessary documents and contacts. And thanks to Kazem Alikani, Emily Bahr, Hailey Bowen, Nick Cali, Katherine Costanza, Madeline Fong Goddard, Jacob Groby, Mark Jernigan, Sarah Michaels, Bob Miller, Hillary Nunez, Joseph Sensebe, Meredith Soniat, Mitchell Theriot, Jeff Thomas, Danny Wiegand, and Ann Wilson for taking the time for answering all my questions.

Next, I would want to thank all my friends that I've met during the past 7.5 years here in Delft. These years have been a lot of fun!

Last, but certainly not least I want to thank my family for supporting me all these years in all the things I've done. I would not have been able to do it without you!

Annabel Visschedijk

March 2014

III Table of Contents

| | |
|---|-----------|
| <i>I Abstract</i> | 4 |
| <i>II Preface</i> | 6 |
| <i>III Table of Contents</i> | 7 |
| <i>IV List of Abbreviations</i> | 9 |
| <i>IV Table of Figures</i> | 10 |
| <i>V Table of Tables</i> | 11 |
| 1 Introduction | 13 |
| 1.1 New Orleans | 13 |
| 1.2 Greater New Orleans Urban Water Plan | 17 |
| 1.3 Goal | 19 |
| 1.4 Thesis Outline | 20 |
| 2 Approach | 21 |
| 2.1 Chain Model | 22 |
| 2.2 Stakeholder Analysis | 23 |
| 2.3 SWOT | 24 |
| 2.4 Constraints | 25 |
| 2.5 MCDA | 25 |
| 3 Reference Projects | 27 |
| 3.1 Implementation of Tree Planting Initiatives in Houston, Albuquerque and Salt Lake County .. | 28 |
| 3.2 Master Plan on Green Infrastructure in New York | 29 |
| 3.3 Grey to Green Initiative in Portland | 30 |
| 3.4 Sustainable City Initiatives in Seattle | 31 |
| 3.5 Stormwater Policies in Twelve Case Studies across the United States | 32 |
| 4 Stakeholder Analysis | 33 |
| 4.1 Organizational Structure | 33 |
| 4.2 Interviews | 38 |
| 4.3 Power and Interest | 39 |
| 5 SWOT Analysis | 43 |
| 5.1 Results | 43 |
| 5.2 Discussion | 46 |
| 6 Constraints | 49 |
| 6.1 Chain Model | 49 |
| 6.2 Funding and Paradigm Shift | 65 |

| | |
|---|------------|
| 6.3 Conclusions..... | 67 |
| 7 MCDA | 69 |
| 7.1 Method | 69 |
| 7.2 Input | 70 |
| 7.4 Results | 71 |
| 7.5 Sensitivity Analysis | 74 |
| 7.6 Conclusions..... | 75 |
| 8 Next Steps | 77 |
| 8.1 Discussion on Results..... | 77 |
| 8.2 Urban Water Plan Recommendations..... | 78 |
| 8.3 Chain Model Recommendations | 79 |
| 8.4 General Approach Recommendations | 83 |
| 8.5 Funding Recommendations..... | 84 |
| 9 Conclusions | 85 |
| 9.1 Results of Analysis | 85 |
| 9.2 Research Approach..... | 86 |
| <i>VI References</i> | <i>87</i> |
| <i>Appendix A: Climate in New Orleans.....</i> | <i>93</i> |
| <i>Appendix B: Greater New Orleans Urban Water Plan</i> | <i>94</i> |
| <i>Appendix C: Interview.....</i> | <i>99</i> |
| <i>Appendix D: Survey.....</i> | <i>101</i> |
| <i>Appendix E: Glossary.....</i> | <i>102</i> |

IV List of Abbreviations

BMP – Best Management Practice

CZO – Comprehensive Zoning Ordinance

DEP – Department of Environmental Protection

DPW – Department of Public Works

EPA – United States Environmental Protection Agency

MCDA – Multi Criteria Decision Analysis

MS₄ – Municipal Separate Storm Sewer System

NORA – New Orleans Redevelopment Authority

RPC – Regional Planning Commission

SELA – South-East Louisiana Urban Flood Damage Reduction Projects

SLFPAE – South-East Louisiana Flood Protection Authority East

SWB – Sewerage and Water Board

SWOT – Strengths, Weaknesses, Opportunities and Threats

USACE – United States Army Corps of Engineers

UWP – Greater New Orleans Urban Water Plan

IV Table of Figures

| | |
|--|----|
| Figure 1: New Orleans and the project area of the Greater New Orleans Urban Water Plan | 14 |
| Figure 2: Levee construction, subsequent development, and Katrina flood area in New Orleans, 1900-2005 (Kates, Colten, Laska, & Leatherman, 2006) | 15 |
| Figure 3: Cross section of New Orleans, from the Mississippi River at the French Quarter to Lake Pontchartrain at the University of New Orleans (Nelson S. A., 2012) | 16 |
| Figure 4: Map showing rate of subsidence for permanent scatterers in New Orleans and vicinity during 2002-2005 in mm/year (Dixon, et al., 2006) | 17 |
| Figure 5 & Figure 6: Drainage canals in New Orleans (www.livingwithwater.com, www.flickr.com). .. | 18 |
| Figure 7: Approach Scheme | 21 |
| Figure 8: Chain model (Adviesunit Resultaatgericht Beleid, Ministerie van Verkeer en Waterstaat, 1997) | 22 |
| Figure 9: Power/Interest Matrix | 24 |
| Figure 10: Organizational Chart | 34 |
| Figure 11: Power/Interest Matrix of the Stakeholders of the Urban Water Plan | 39 |
| Figure 12: Chain Model with the Addition of Politics | 49 |
| Figure 13: Lakeview Floating Streets, the proposal and the stakeholders | 80 |
| Figure 14: Rainfall even in New Orleans on May 8, 1995 (source: www.livingwithwater.com..... | 93 |
| Figure 15: Average yearly temperature and precipitation from 1981-2010 (source: National Climatic Data Center) | 93 |
| Figure 16: Project areas within the Urban Water Plan | 95 |

V Table of Tables

| | |
|--|----|
| Table 1: Policy methods used to support green infrastructure | 32 |
| Table 2: Stakeholders of the Urban Water Plan | 37 |
| Table 3: Stakeholders Analysis | 41 |
| Table 4: Results of the SWOT analysis..... | 43 |
| Table 5: Constraints for Implementation of the Urban Water Plan | 50 |
| Table 6: General Public Survey on the Urban Water Plan..... | 54 |
| Table 7: Comparison of Ranking of the Strategies by General Public and Stakeholders..... | 55 |
| Table 8: Media on the Urban Water Plan | 56 |
| Table 9: Weights of Criteria and Constraints | 70 |
| Table 10: Performance of the elements on constraints and criteria | 71 |
| Table 11: Credibility Matrix..... | 71 |
| Table 12: Upward and Downward Distillation Process | 73 |

Introduction

In 2005 the whole world learned about New Orleans' water issues when Hurricane Katrina struck and inundated more than 80% of the city. When people talk about New Orleans and water issues it usually involves hurricanes which cause big storm surges in the Gulf of Mexico and Lake Pontchartrain, yet it is less known that New Orleans has been coping with water issues every year, due to severe rainfall events in the spring and summer. Hurricanes can also account for these big rainfall events¹. Flooding in some neighborhoods occur with every inch or two of rainfall. Part of the problem is that the drainage system in New Orleans is not able to cope with the rainfall events, which is made even more difficult due to the ongoing subsidence of New Orleans. These issues are now being addressed in a comprehensive plan called the Greater New Orleans Urban Water Plan that has been presented in September of last year. The next step is implementation of this plan. In this chapter an introduction is given on the issues in New Orleans, the Greater New Orleans Urban Water Plan and the implementation of comprehensive plans. This will lead to the goal of my thesis.

1.1 New Orleans

New Orleans is located in the state Louisiana in south of the United States, with Lake Pontchartrain in the north and the Mississippi River in the south, see Figure 1. The Greater New Orleans comprises eight parishes, of which three parishes are located in the project area of the Greater New Orleans Urban Water Plan: Jefferson Parish, Orleans Parish (also called the city of New Orleans) and St. Bernard Parish. Figure 1 shows the project area. Jefferson Parish and Orleans Parish also have parts situated on the other side of the Mississippi. The areas in the project area are also considered the east bank of the parishes, because over the whole course the Mississippi River travels from north to south.

¹ Hurricane Isaac in 2012 caused big floods due to rainfall. It was a category 1 hurricane, but since it moved very slowly, it dropped a lot of water in certain areas. It didn't cause the big storm surges as Hurricane Katrina did in 2005, but did cause floods (Berg, 2013).

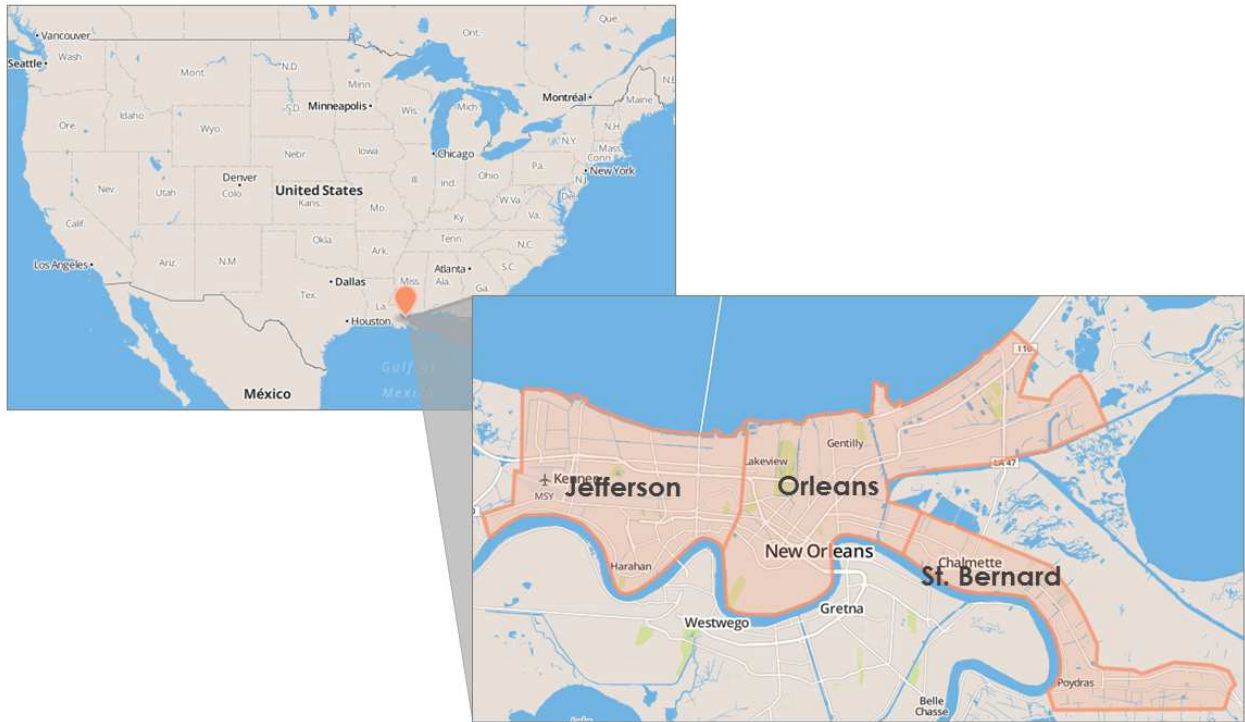


Figure 1: New Orleans and the project area of the Greater New Orleans Urban Water Plan

1.1.1 Development of New Orleans

New Orleans was founded in 1718 on the levees of the Mississippi. These levees were created naturally by the overtopping of the streams. During a flood, sediment was deposited on the banks, which eventually lead to natural levees (Nelson S. A., 2012). This location was a relatively high and dry spot between the Mississippi River and Lake Pontchartrain, with elevations of about 12 feet above sea level (Colton, 2009). Due to the rise in commerce along the Mississippi River, which accelerated after steam boats were used, New Orleans grew from a small city into a major port city. By 1860 it was one of the largest cities of the United States with a population of nearly 170,000. After the discovery of oil and natural gas along the Gulf's continental shelf and the continued expansion of river commerce, New Orleans counted 627,525 inhabitants in 1960 (Congleton, 2006).

As the amount of inhabitants in New Orleans grew bigger, the city, which was essentially along the natural levees of the Mississippi River, expanded towards Lake Pontchartrain in the 20th century. From 1900 to 1950 suburbs were developed with a complex system of levees and pumps. This system, constructed in the 1920s and the 1930s by the Army Corps of Engineers, kept the city dry and operational and helped dry out the wetlands in north of the city to enable urbanization. By building a massive 9-foot concrete seawall, urbanization towards the lake was encouraged. From 1965 to 2000 the last round of levees was build and reconstructed after Hurricane Betsy (1965). This improved and expanded levee system led to a doubling of the protected area, as can be seen in Figure 2. Together with these levees, new and much larger drainage systems were build (Comfort, 2006; Congleton, 2006; Kates, Colten, Laska, & Leatherman, 2006).

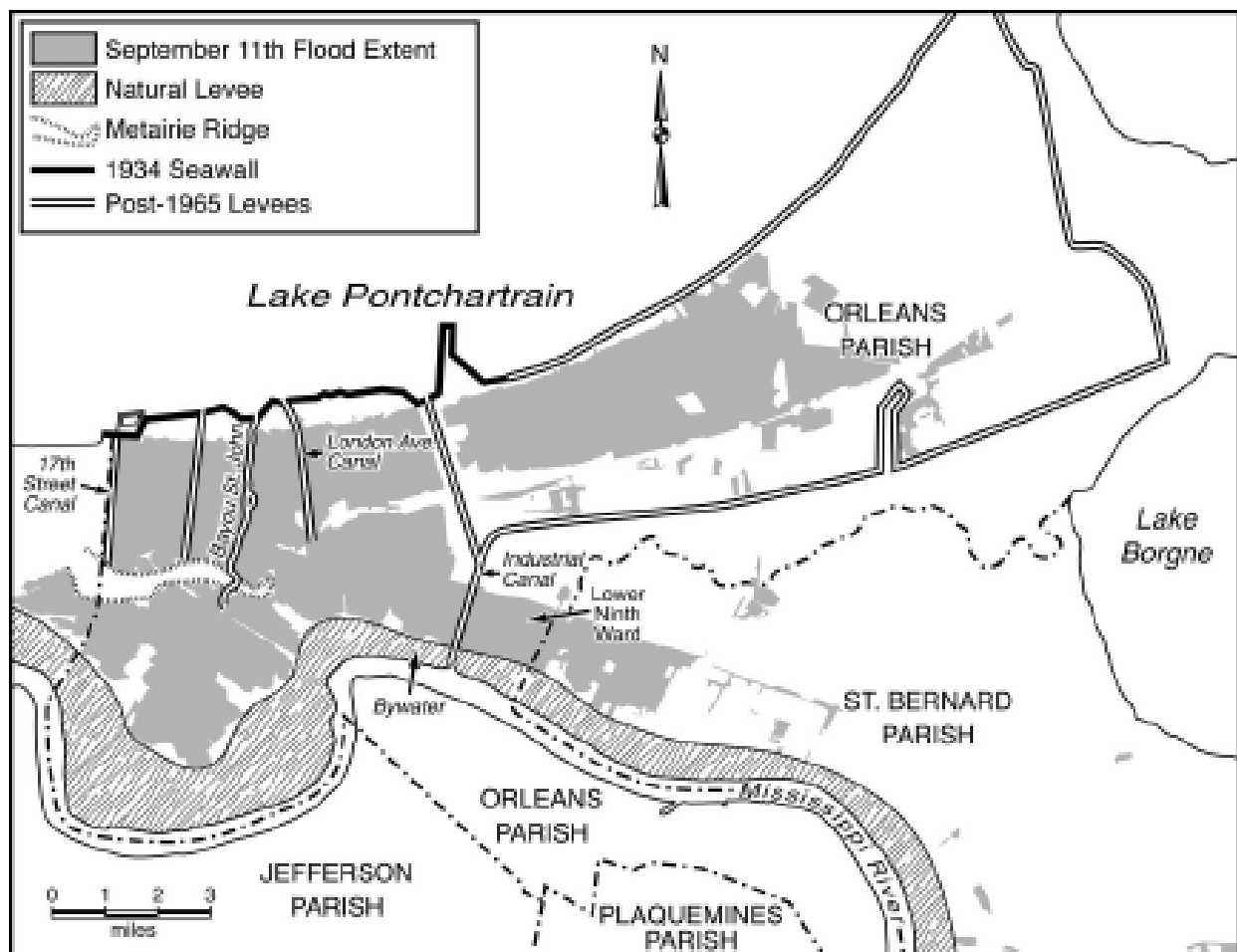


Figure 2: Levee construction, subsequent development, and Katrina flood area in New Orleans, 1900-2005 (Kates, Colten, Laska, & Leatherman, 2006)

1.1.2 Flooding and Drainage in New Orleans²

As the original city of New Orleans was initially higher than the Mississippi, it was protected from minor floods. However, flooding has been a problem from the very beginning, since drainage was a problem caused by the topography of the region. New Orleans was built in a bowl-shaped area, as seen in Figure 3 (Nelson S. A., 2012). Between 1735 and 1871 there are 38 recorded floods caused by the river, rainfall and Lake Pontchartrain (Congleton, 2006). During this period the Carondelet Canal and the New Basin Canal were built to improve drainage and facilitate shipping. Also the New Orleans Drainage Company was established to improve the city's drainage system as well as to drain the land around the city, but capacity was too low to prevent regular overflowing of the drainage canals. By tripling the capacity of the drainage system in the beginning of the 1900s, water could now be pumped four times higher, allowing for the canals to be lowered from 3 meters (10 feet) to 4.5 meters (15 feet) below the surface. It was now possible to build cellars under new buildings with floors located at about 4 meters (12-15 feet) below surface level (Meyer, Morris, & Waggoner, 2009). Currently the city drains an area of approximately 243 km² (Boyd, Palmeri, Zhang, & Grimm, 2004), which receives an average annual rainfall of approximately 160 cm (62 inches)³ (Waggoner &

² This paragraph focuses on Orleans Parish; the other two parishes are left out in this part, since it is only meant to describe the problems that the area is facing. Jefferson Parish and St. Bernard have the same issues.

³ More information on the climate in New Orleans can be found in Appendix A.

Ball Architects, 2013). In comparison, the Netherlands has an average annual rainfall of 85 cm (33 inches) (Koninklijk Nederlands Meteorologisch Instituut, 2012). The current drainage system consists of 22 pumping station with a capacity of 110 million m³/day and roughly 290 km (180 miles) surface and underground drainage canals, which mostly discharge into Lake Pontchartrain (Balters, 2011; Sewerage and Water Board of New Orleans, 2013). However, this system is still very vulnerable to intensive rainfall. Rainfalls in 1995 flooded 40,000 homes, killed 7 people and caused damage of about a billion dollars (Meyer, Morris, & Waggoner, 2009). Floods due to rainfall is much more common in New Orleans than floods due to breaches in floodwalls caused by surges from outside the hurricane protection system, as was the case when Hurricane Katrina struck.

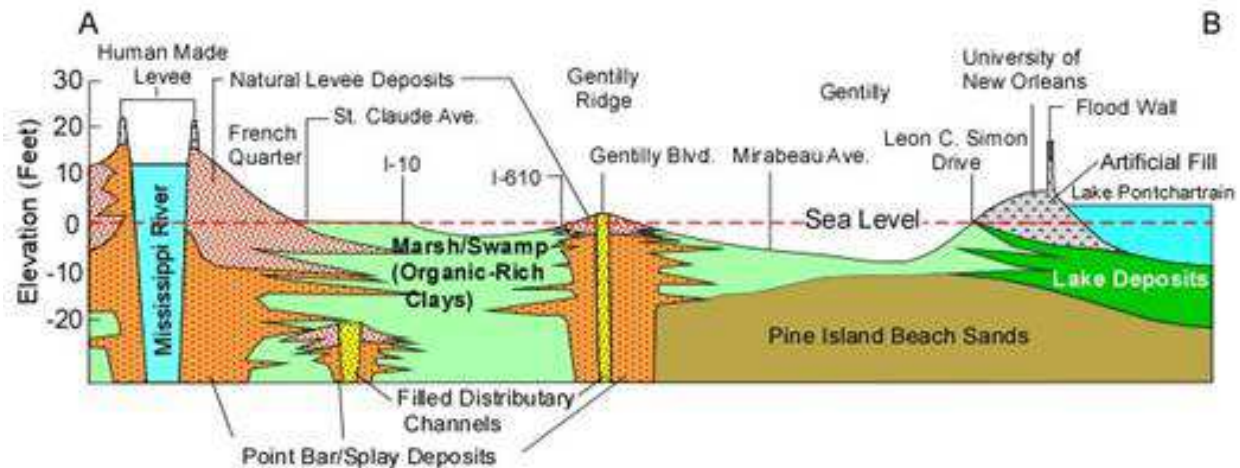


Figure 3: Cross section of New Orleans, from the Mississippi River at the French Quarter to Lake Pontchartrain at the University of New Orleans (Nelson S. A., 2012)

1.1.3 Subsidence

The subsiding of New Orleans has made it more and more difficult to protect it from flooding. In Figure 4 a satellite survey can be seen, showing the rate of subsidence in the period 2002-2005. This subsidence has contributed significantly to flood damage following recent hurricanes when flood water overtopped or breached the levees and collected within the now below-sea-level terrain (Colton, 2009). The satellite survey shows that some of the levee breaches during Hurricane Katrina were located in places where the rate of subsidence was the highest (Dixon, et al., 2006). The subsidence of New Orleans also makes it more difficult to pump out storm water. So basically, the more the city sinks, the more the city floods.

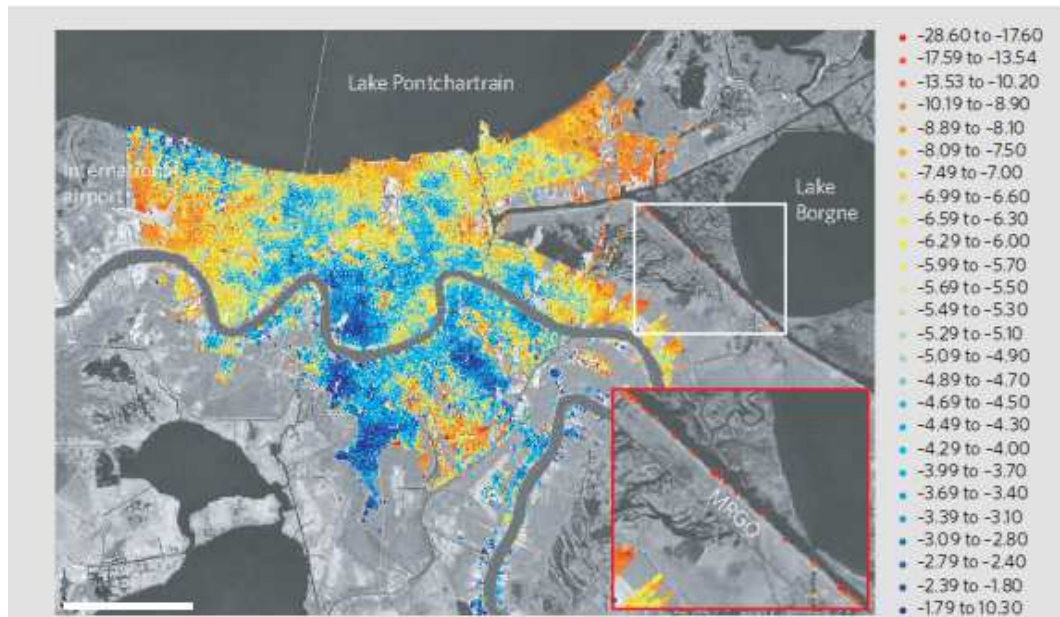


Figure 4: Map showing rate of subsidence for permanent scatterers in New Orleans and vicinity during 2002-2005 in mm/year (Dixon, et al., 2006)

The sinking of New Orleans has different causes. One of these is the various levee and drainage projects. Since the levees prevented the replenishing of the soils, the drainage system removed surface and groundwater, and there is no surface water recharge, the peaty soils compressed and oxidized. The drainage system pumps out water regularly to compensate for groundwater seepage into the canals. So even more water is drained out of the ground, causing the soils to dry out and subside even more. Over the years this is one of the major causes for New Orleans to sink below sea level (Fischetti, 2001; Comfort, 2006; Congleton, 2006; Kates, Colten, Laska, & Leatherman, 2006; Colton, 2009; Meyer, Morris, & Waggonner, 2009). This subsurface subsidence is not the only reason for subsidence in this region; however it is the only type of subsidence that is being tackled in the Urban Water Plan. Other types of subsidence are aquifer compaction and isostatic and tectonic subsidence (Meyer, Morris, & Waggonner, 2009).

1.2 Greater New Orleans Urban Water Plan

In March 2011 Greater New Orleans, Inc.⁴ chose Waggonner & Ball Architect to develop a water management strategy for New Orleans to address these issues. The Greater New Orleans Urban Water Plan (UWP) addresses flooding caused by heavy rainfall and soil subsidence caused by the pumping of groundwater. Besides these two issues it takes into account the opportunities at hand to use the water resources (functionally, aesthetically and ecologically) in order to build resiliency and improve the quality of life in the communities on the East Bank of the Mississippi River in Jefferson, Orleans, and St. Bernard Parishes. The major goals of the UWP are to increase safety, provide economic opportunity, and improve quality of life. It provides a new approach to water management in New Orleans by reintroducing water into the city and introducing multiple lines of defense, which already is a foundational principle for all Louisiana coastal planning. Even though New Orleans is surrounded by water, it is nowhere to be found in the city. Water that is above ground is mostly hidden, not accessible or unsightly, see Figure 5 and 6.

⁴ Greater New Orleans, Inc. or GNO Inc. is a regional economic development alliance that serves the Greater New Orleans Area. It is a non-governmental organization.



Figure 5 & Figure 6: Drainage canals in New Orleans (www.livingwithwater.com, www.flickr.com)

The new vision for New Orleans as a water city is based on the principles of circulate, recharge, slow, store and to pump only when necessary. To achieve this, the strategy includes visible water storage to coop with soils subsidence and flooding and proposes a system to circulate water in New Orleans by linking canals and major infrastructure. The designs are focused on storm water management with long term goals. The UWP makes use of water management elements like bioretention & infiltration, canal improvement and pervious paving. Examples of these elements are storage basins in parks, since these are best sited in large parcels of publicly-owned land and attract wildlife and humans. Raise the water levels in all the drainage canals for recharging groundwater. Monitoring and developing the capability to make real-time adjustments to water levels in the canals so higher water levels can safely be maintained and making sure that operators are able to lower water levels in advance of a heavy rainfall event to provide the needed freeboard. Making use of pervious paving in low-traffic areas, so the runoff to the drainage system can be delayed and reduced. The UWP consist of several demonstration projects which goal is to educate and show the general public as well as the stakeholders how these water management elements work. More information on the UWP with its principles, water management elements and demonstration projects can be found in Appendix B.

An economic cost-benefit analysis was done on the Urban Water Plan. The expected costs for implementation of the plan are \$6.2 billion. The impact of 50 years will give a reduction of \$8 billion dollars for flood damages, \$2.2 billion for subsidence damage, \$609 million in insurance premiums and an increase of \$183 million in property values. It has also been estimated that it will have regional economic impact of \$11.3 billion due to the amount of activity in the supporting industry sectors and creating jobs.

1.2.1 Implementation of the Urban Water Plan

Now that the UWP is completed, the next step is implementation. In literature several constraints can be found when wanting to implement such integrated urban storm water management plans. Most of these constraints have been acknowledged for some time and are found to be more socio-institutional rather than technical (Ingram, Mann, Weatherford, & Cortner, 1984; Niemczynowicz, 1999; Blomquist, Heikkila, & Schlager, 2004; Mitchell, 2006; Brown R. R., 2008). Brown & Farrelly (2009) discovered 12 constraint types after analyzing 53 different studies in the field of integrated urban water management and other similar fields. Uncoordinated institutional framework, limits of regulatory framework, and unclear, fragmented roles and responsibilities are a few of the more common constraints found. In project management literature it is very well known that for a project

to be a success, the interest of the key stakeholders should be taken into account and good stakeholder management can lead to higher project performances in every project phase (Achterkamp & Vos, 2008). Also Ingram et al (1984) already suggested that a thorough stakeholder analysis is a solution to overcome implementation constraints. Hermans (2005) concludes after performing several case studies that actor analysis is a promising tool, but not an easy solution, to close the gap between water experts and policy makers.

The UWP acknowledges the constraints as well, by stating that implementation will depend on that every element of the UWP must be someone's responsibility or should become someone's responsibility, choices will have to be made and priorities need to be set and that the UWP will require ongoing cooperation and coordination between governments and citizens (Greater New Orleans Comprehensive, Integrated & Sustainable Water Management Strategy, 2013).

As the implementation will probably be the responsibility of local governments (Louisiana Resiliency Assistance Program, 2012; Greater New Orleans Comprehensive, Integrated & Sustainable Water Management Strategy, 2013) it is important that these constraints are overcome. Especially since Greater New Orleans has a complicated organizational structure. The project area of the UWP consists of parts of the Jefferson, Orleans and St. Bernard parish. Each of these areas has their own departments or organizations that are responsible for drainage and flood control. For example, Jefferson parish has a governmental department which is responsible for drainage and flood control, whereas Orleans parish has its own sewerage and water board. For the implementation of the UWP these departments/organizations will need to work together to come to a good result. A stakeholder analysis could identify constraints that make this more difficult.

1.3 Goal

In this master thesis next steps will be identified based on the constraints that the UWP faces. These next steps will also include how a prioritization can be made towards which elements are better to implement based on the performance of each action with regards to criteria, such as flood reduction and subsidence. By making this prioritization it will be possible to reveal which elements are most difficult to implement due to the socio-institutional constraints. The stakeholder analysis will reveal which stakeholders are most important. These stakeholders will be asked to conduct a SWOT-analysis and to identify constraints they foresee. To identify these constraints the chain model (in Dutch 'Ketenmodel') will be used as a guideline. The chain model is a tool which was developed in the Netherlands to make implementing certain policies easier. These constraints as well as the performances of each the elements will be the input for the prioritization which will be made with a Multi Criteria Decision Analysis.

This leads to the goal of my master thesis:

"Identifying the next steps for the implementation of the Greater New Orleans Urban Water Plan by making a **Multi Criteria Decision Analysis** based on a **chain model stakeholders analysis** and **social-economic values** of the different actions in order to overcome (social-institutional) constraints facing implementation."

1.4 Thesis Outline

Following this introduction the next chapter the approach will be explained in more detail including a description of each of the methods used. In chapter 3 reference projects and literature on implementation of similar types of projects will be discussed. Chapter 4, 5, 6 and 7 will present the results, with respectively a stakeholders analysis, a SWOT analysis, the identified constraints and the Multi-Criteria Decision Analysis. Each of these chapters will also provide a discussion on the results. Chapter 8 will include a discussion on the results and methods used as well as what next steps can be taken for implementation of the UWP. Chapter 9 will provide the conclusions of this thesis.

Approach

This chapter shows the approach to how the goal of will be reached and some terms will be more specified. In the figure beneath a scheme is shown of how all the different aspects of the research come together. The final result is an implementation plan which contains improvements for the Urban Water Plan and improvements for the stakeholder in order to make implementation easier. It also contains an MCDA with which conducts a prioritization on a pilot project. It shows how this can be used for all other projects in UWP to make a prioritization based on the constraints that a project with different strategies encounters and the way these different strategies perform in terms of certain criteria like flood control and preventing subsidence.

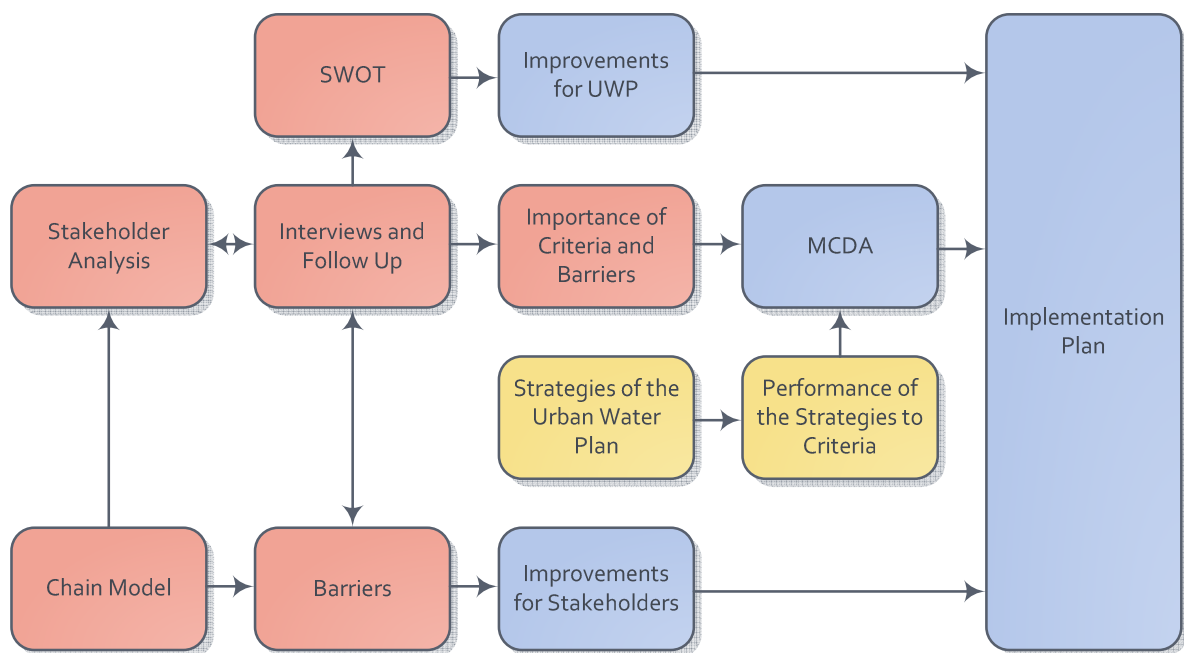


Figure 7: Approach Scheme

The data from the red boxes will follow from a literature study and interviews, the data from the yellow boxes follow from the UWP and these form the outcome which is shown in the blue boxes. In the next paragraphs the scheme will be elaborated in more detail with a paragraph on chain model a paragraph on the stakeholders analysis, a paragraph on the SWOT analysis and a paragraph on the MCDA.

2.1 Chain Model

The chain model (in Dutch 'het ketenmodel') was developed by a workgroup of the Dutch Ministry of Public Works. Since actions by government authorities have a big impact on society, policy subjects are becoming more and more complex, and finding a balance between all different interests is becoming more difficult, policy implementation were postponed or not done at all. A new way of making policy was needed, so the chain model was developed. The basis of the chain model is to involve different stakeholders from the very beginning. These experts could help state what policy issues are and what causes them. By involving these stakeholders as soon as possible, there will be more public support for the actions and the feasibility of these actions. The chain model is as follows:

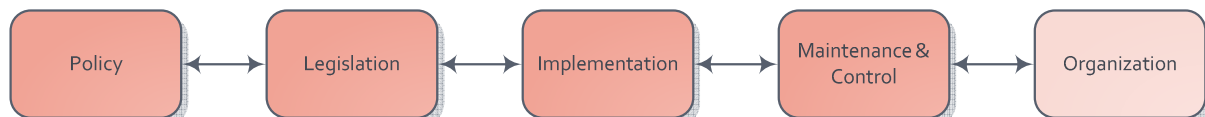


Figure 8: Chain model (Adviesunit Resultaatgericht Beleid, Ministerie van Verkeer en Waterstaat, 1997)

Policy is made in the first box, by policymakers. The second box represents the people/organizations that make the legislations to make policy possible. The third box is the implementers. They implement and make use of the legislation and take care that policy is made possible. The fourth box makes sure that the work that has been done in the previous boxes is maintained and controlled. Basically, what the policymakers decide influences the work of all stakeholders in the next boxes. Even though the work of these stakeholders is influenced by policymakers, they are hardly ever consulted for making new policy, not for their experience on the current policy and not for how they think of these issues. Therefore it is not strange that policy often seems difficult to implement (resources don't suit the goals, procedures are contradictory) or to maintain (rules are unclear, low chance of getting caught). Working with the chain model makes policymakers, but also people in other columns aware of the connections between the components. It is very important that there is exchange of information and experience. This demands new requirements toward organization, the last box. Basically the chain is developed to prevent problems during implementation and enforcement/control and face these challenges beforehand(Adviesunit Resultaatgericht Beleid, Ministerie van Verkeer en Waterstaat, 1997).

An example for how this works in practice is the project Rotterdam Water City 2035. This is a project in which for the first time urban planners and urban water experts developed a long term vision for the city. As it was a non-official policy, more radical ideas and a longer planning horizon were possible than in official policy documents. Many innovations, like green roofs and water retention squares were eventually included in official policy. Mainstreaming was further enabled by political and executive support as well as the presence of change agents in all participating organizations (De Graaf, 2009). The need for political and executive support can be seen as the first 4 components of the chain model and the change in organization is the last component of the chain model.

The chain model is the starting point of the scheme and will first be used to identify stakeholders who can be asked for input for the SWOT analysis and identify constraints for implementation. As mentioned, master plans tend to follow the chain model and by doing so have stakeholders in each part of the chain model. By using the chain model as a starting point to identify stakeholders it is believed that the most important stakeholders will be identified.

2.2 Stakeholder Analysis

The goal is to identify how a stakeholder stands towards the UWP and how willing the stakeholder is towards implementation of the UWP. By ranking the stakeholders by influence and stake it can be seen which constraints and goals will be most important. As the most influential stakeholders and the stakeholders with the highest stake will probably make it easier or harder to overcome certain constraints or make it easier or harder to reach certain goals.

The definition of a stakeholder varies in literature. Most articles refer to a stakeholder as “an individual or organization with a (vested) interest in the project (i.e. outcome, success)” or “an individual or organization that can affect or is affected by the project” (Achterkamp & Vos, 2008). A role-based stakeholder identification method will be used. The roles are the first four parts of the chain model as seen in Figure 8, which are mostly stakeholders that can affect the project. The reason for the use of the chain model for the different roles is that the stakeholders will be asked to give input to the SWOT analysis and identify constraints. It is believed that to answer these questions the stakeholder should have notion of how processes in government work, how the organizational structure is set up as well as have some experience with it. Therefore other groups that are generally considered to be stakeholders, like for example citizens of the project area, are not considered as stakeholders in this thesis. As shown in the previous paragraph projects and master plans tend to follow different parts of the chain model. By using this definition for a stakeholder it is believed that the constraints in the chain model will be found, which, when being overcome, can lead to a successful implementation. Therefore a stakeholder is from now on defined as being part of the chain model.

The stakeholder analysis consists of four parts: the identification of the stakeholders and finding data about these stakeholders, analyzing the data of the stakeholders and validating the stakeholder analysis. The stakeholder analysis will be used to identify the most important stakeholders, which will be interviewed.

2.2.1 Identification

The identification of stakeholders has partly already been done by using the chain model. To be sure that all the necessary stakeholders have been identified a second step is needed. In literature there are several other ways found to search for identifying stakeholders. The most common used is by performing a brainstorm with either already identified key stakeholders (WATECO, 2003; Jepsen & Eskerod, 2009) or a project group (Achterkamp & Vos, 2008). Another way of identifying stakeholders is by ‘snowballing’. The actors that already have been identified will be asked to name other stakeholders in his/her area. The list is further extended by asking these new identified stakeholders the same question. This snowballing continues until no new stakeholders are identified (Timmermans, 2009). The latter method was chosen to extend the list of stakeholders. A big advantage of this method is that it can already be done by email. In the first interviews the stakeholders were also asked to identify more stakeholders.

2.2.2 Data

The data that is collected is done by the interviews and by document research. Data collection by stakeholders is generally favored since it is expected to increase the transparency of the analysis procedure and to reduce the bias of the analyst (Hermans, 2005). The questions of the interview can be found in Appendix C.

2.2.3 Analysis

In this part all the input data will be analyzed and put in an overview. This overview will show which stakeholders are involved, how they are involved, how much influence they have, and their willingness to get involved. By putting them in a power/interest matrix as seen in Figure 9 it can be seen how interested each stakeholder is to pursue with the Urban Water Plan or oppose of it and if they have the power to do so. Once placed in the matrix it can be seen how a stakeholder should be approached (Olander & Landin, 2005; Johnson, Scholes, & Whittington, 2008). In this analysis also an evaluation of the role of the stakeholder with regards to the Urban Water Plan will be given and how they relate to the principals of the Urban Water Plan.

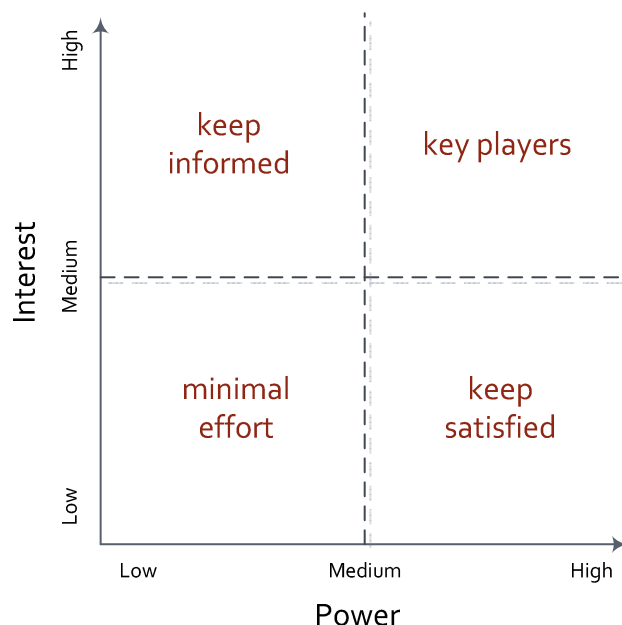


Figure 9: Power/Interest Matrix

2.2.4 Validation

An important last part that will be done is the validation of the stakeholder analysis. The outcome will be presented to a few experts to see if it matches what they would expect as an outcome. If necessary, changes will need to be made in the stakeholder analysis.

2.3 SWOT

A SWOT analysis is a support tool used for decision-making and is mostly used to systematically analyze an idea, organization, person, product, program or project by looking at the internal and external environment. It identifies the strengths (elements to leverage and build on) and weaknesses (areas to seek assistance and support) plus opportunities (areas to leverage for program advantages) and threats (elements that can hinder the program) (Mainali, Ngo, Guo, Pham, Wang, & Johnston, 2011). It can identify internal and external factors that are favorable and unfavorable to

achieving that specific objective. Strengths and weaknesses are internal, opportunities and threats are external. Strengths can be offset by weaknesses and threats should be converted to opportunities (Arslan & Er, 2008).

During the interviews with the stakeholders they will also be asked to conduct a SWOT analysis with regards to how the UWP is to their organization. An example of how the questions will be asked is: "What are the strengths of the UWP with regards to your organization or department?". By making a SWOT analysis of the UWP constraints can be identified, which have not been taken into account yet. The outcome of the SWOT analysis can reveal how the stakeholders are viewing the UWP and it also shows the willingness towards implementing the UWP. The weaknesses and threats of the UWP are important to take into account for implementation of the plan and can be used to make improvements to the plan. In short, SWOT analysis can provide the critical factors which need to be considered for a successful implementation of the UWP.

2.4 Constraints

In the interviews the stakeholders will be asked to identify constraints. First they will be asked to identify constraints in general, and then more specific with regards to the different parts of the chain model. The most frequent mentioned constraints will then be used as an input for the MCDA. Since these constraints are mostly part of the chain model, overcoming these constraints will lead to not only improvements for the plan, but can also lead to recommendations for the stakeholders in order to easily implement the plan.

2.5 MCDA

Multi Criteria Decision-Making Analysis (MCDA) is a tool to help decision makers organize and synthesize information in such a way that all criteria and factors have been properly taken into account, so they feel comfortable and confident about the decision made (Belton & Stewart, 2002).

The Multi Criteria Decision Analysis will be used on elements of the UWP, like bioretention & infiltration and pervious pavement. The input will be the previously mentioned constraints and will be weighted by the stakeholders. The stakeholders will also weight the criteria that follow from the UWP. The performances of the element towards the constraints will be weighted by the stakeholders, and the performances towards the criteria can be found in the UWP. The output will be a prioritization of the elements, which could be used to develop an implementation strategy.

There are lots of MCDA methods to choose from. This thesis makes use of ELECTRE III. This method is based on outranking and produces a list with all the alternatives ranked from best to worst. These alternatives can be equally as good. It has a sound theoretical basis where it does not include cardinalization and it can handle qualitative data. Finally, it is a method that does not require too much input from the stakeholders and can deal with a large amount of criteria (10 or more) (Roy, 1991; Rogers & Bruen, 2000; Pruyt, 2009).

How ELECTRE III is done, is shown in more detail in chapter 7 with the use of an example.

Reference Projects

Within the United States several of green infrastructure and integrated water management projects have been developed and implemented. Though none of these projects have been designed in such a comprehensive manner as the Urban Water Plan, the implementation of these projects can show ways how it can be done and reveal some important lessons to learn from.

A couple projects and studies were found with promising results on implementation. Other projects and studies mentioned here deemed to include useful approaches which could be considered for the implementation of the Greater New Orleans Urban Water Plan. The studies and reference projects that are elaborated on in this chapter focus on the United States, since organizational structures, implementation culture, funding mechanisms are somewhat similar across the United States it is expected that implementation lessons are best learned from projects in the States. The following paragraphs focus on the implementation of tree planting initiatives in Houston, Albuquerque and Salt Lake County, the master plan on green infrastructure in New York, the Grey to Green Initiative in Portland, sustainable city initiatives in Seattle and a study conducted by EPA on stormwater policies to support green infrastructure in various cities across the country. These studies include different approaches towards implementation and different ways of starting up plans and initiatives. For example, in New York the first ideas of the plan started in city government, whereas in Seattle and the tree-planting initiatives started on a more grassroots level by for example nonprofit organizations.

3.1 Implementation of Tree Planting Initiatives in Houston, Albuquerque and Salt Lake County

Green infrastructure is being implemented in a bottom-up approach in a growing number and on a larger scale. However, little research, literature or documents can be found on these types of approaches. This has also been expressed by Young (2011), who conducted a study towards tree planning initiatives across the United States to research if there is enough experience among stakeholders and city staff to implement green infrastructure. During his research he interviewed stakeholders and city staff from nine different cities which had a large-scale, urban tree-planting program with mayoral sponsorship or endorsement. Of these nine cities, three are worth mentioning due to the grassroots implementation of these programs; Houston⁵, Albuquerque⁶ and Salt Lake County⁷.

The interviewees of these three cities in the study underscored the importance of sustained public sector, however they all mention that due to a lack of institutionalization or business and outreach plans initiatives tend to drift. In Salt Lake County, for example, the absence of dedicated funding combined with a lack of outreach made it more difficult to move forward in a civic culture that does not prioritize urban trees. The situation in Albuquerque and Houston was similar. In Houston, at the start of the initiative, the original business plan suggested that for a successful implementation one third of the program's funding should be provided by the city, and the rest would be raised privately. This formula was held during the first year, but soon was let go, due to recession and because support was replaced with a general fund instead of a dedicated source. Funding had become more vulnerable since it then needed to rely on a general fund, corporate donations, and the mayor's political viability.

In Salt Lake County stakeholders and city staff observed a big gap between public awareness planning and effectiveness. At the starting of the initiative the mayor and other public official's actively showed their engagement at planting and public relations events. Yet, after the launch the momentum dissolved. Even though there were enough outreach efforts that were reaching media and political representatives, it did not gain sustained public education and involvement.

The study of Young (2011) suggests that with the absence of direct municipal implementation, initial planning and stewardship responsibilities can be given to private or non-profit actors. They can provide short-term advancement and maintenance of green infrastructure investments. However, long-term maintenance still needs to be addressed and non-profits and volunteers can't provide the same tree-planting and long-term maintenance as the public sector can without the proper financial support. As noted by interviewees in Salt Lake County, Albuquerque, and Houston, variability in corporate funding and reliance on non-profits, citizen's groups, and individuals cannot replace the full commitment of a city's budget and workforce in supporting citywide infrastructure. The study does however conclude that community-level engagement could become an important factor in implementing plans and protecting green infrastructure investments, budget priority, and interest.

⁵ The tree planting initiative in Houston was launched in 2008 by Trees for Houston, a non-profit organization, and is entirely privately financed (Pincetl, 2009). Its goal was to plant 1 million trees in 5 years, which makes it one of the most ambitious TPI's in the Young's study. At the end of 2010 over 400 thousand trees were planted.

⁶ In 2004 Albuquerque launched a tree planting initiative. The goal is to plant 75 thousand trees in 2 years. In 2010 30 thousand trees were planted.

⁷ Salt Lake County launched its' tree planting initiative in 2007. In 10 years 1 million trees need to be planted. At the end of 2010 little more than 150 thousand have been planted.

Lesson Learned:

- Grassroots implementation can be a successful alternative to start implementation instead of doing it by the local government.
- Grassroots implementation cannot replace the full commitment of a city's budget and workforce.

3.2 Master Plan on Green Infrastructure in New York

The improvement of water quality is the base the Green Infrastructure Plan of New York, a master plan in green infrastructure for New York City (Department of Environmental Protection, 2010). The goal is to reduce the combined sewer overflows that discharge a mixture of untreated sewage and stormwater runoff when it rains. Traditional approaches to reduce these overflows would be to construct additional, larger infrastructure, but these approaches are quite expensive and do not provide the sustainability benefits that the general public of NYC would expect from these multi-billion dollar investments. The Plan provides an alternative approach to improving water quality which integrates green infrastructure, like bioswales and green roofs, with investments to optimize the existing system and to build targeted, smaller-scale traditional or "grey" infrastructure. The goals for the green infrastructure are to manage 10% of the runoff from impervious surfaces in combined sewer watersheds through detention and infiltration source controls. The plan has been developed by the Department of Environmental Protection in collaboration with other city entities.

The Green Infrastructure Plan of New York contained a number of concrete steps to begin early implementation. These steps included the preparation of a Green Infrastructure Fund, creating an inter-agency partnership, building demonstration projects, partnering in with community groups and developing a stormwater management standard for new construction and redevelopment.

The City is prepared to spend up to \$1.5 billion over 20 years and \$187 million in capital funds over the next four years. The City will also prepare a Green Infrastructure Fund to supply capital and maintenance funds for the incorporation of green infrastructure in planned capital projects like roadway reconstructions. These resources are supposed to ensure that implementation of the Green Infrastructure Plan can start incrementally, and that the City will immediately obtain benefits of green infrastructure, which will only increase over time. The Department of Environmental Protection (DEP) will also pursue other funding sources, like Clean Water State Revolving Funds and federal funds for green infrastructure, private funds, ecological restoration funding from the Army Corps of Engineers and other governmental partners, and stewardship and other resource commitments from community and civic groups.

This Fund will be used by a Green Infrastructure Task Force which comprises of city agencies, and is led by the Mayor's Office and the DEP. The Task Force will include various agencies with experience in planning, designing, and building stormwater management techniques. The Green Infrastructure Task Forces' task is to incorporate stormwater management into roadway, sidewalk and other capital projects and to provide for the maintenance of green infrastructure. Partnerships are considered critical for a successful implementation. The DEP is working on several fronts to enlist community-based organizations and local universities in the implementation of green implementation. It has also issued grants to local environmental groups and academic institutions to build research-based demonstration projects such as green roofs, permeable pavement, curbside swales, rain gardens and restored wetlands.

In 2012 the following accomplishments were achieved:

- A promulgated stormwater performance standard was implemented in July 2012, in which new development and redevelopment are required to manage stormwater runoff;
- A signed agreement was made between DEP and the New York Housing Authority (NYCHA) for a five year term in which maintenance roles are established;
- 14 right-of-way bioswales were constructed; and,
- Five schoolyard site designs were reviewed for green infrastructure retrofits and green infrastructure designs were made for a number of NYCHA facilities.

Lessons Learned:

- A city government approach for implementation leads to quick results in a short amount of time, which include policies changes and responsibility agreements;
- A Task Force is an alternative method to get the participation of city agencies.

3.3 Grey to Green Initiative in Portland

The Grey to Green Initiative helps implement the Portland Watershed Management Plan, a plan that aims at improving Portland's watershed conditions by improving conditions of hydrology, physical habitat, water quality and biological communities(Entrix, 2010). This is done by implementing five strategies: stormwater management; re-vegetation; aquatic and terrestrial enhancement; protection and policy; operations and maintenance; education, involvement, and stewardship. The Grey to Green Initiative intends to accelerate the implementation of this plan and to increase the amount of green infrastructure in the city, which includes constructing green roofs and green streets⁸, planting trees in urban areas, and acquiring and protecting open spaces. The Initiative has been developed by the Portland Bureau of Environmental Services.

The Grey to Green Initiatives partners with residents, community organizations, and businesses in projects that build new infrastructure and at the same time will green the city. Between 2008 and 2013 the Grey to Green initiative achieved the following with the help of public and private partners (Environmental Services of the City of Portland, 2014):

- More than 32 thousand trees have been planted on streets and in yards;
- 867 green street facilities have been completed, and more projects are underway;
- 191 ecoroofs have been completed which cover 11 acres of rooftop;
- 406 acres of natural areas have been purchased to help protect natural stormwater management functions and clean water sources.

Lessons Learned:

- Adding a separate initiative that focuses on certain aspects of the bigger plan can pay off with quick results in a small amount of time.

⁸ Green streets are vegetated curb extensions, street side planters, or infiltration basins that collect stormwater runoff from streets.

3.4 Sustainable City Initiatives in Seattle

Seattle is one of the early adopters of sustainable cities initiatives. The first ideas on a sustainable city in Seattle occurred in local grassroots organizations and from there on developed into a comprehensive master plan for the city which has been adopted by city government (Portney, 2005). Broad-based participatory processes were used for conceptualizing the sustainable plans, where residents were allowed to express their views on what it meant for their place to be sustainable. Sustainability values were developed with the participation of more than 250 volunteers. These participants had positions in government, businesses and civic organizations. The purpose of this involvement was to maximize the likelihood of a broad consensus in support of the uses of these values. Also the process of involving volunteers could result into community-building effort. Outreach was done to raise the collective awareness of the residents to understand how consumer attitudes and behavior would need to change to achieve sustainability goals. "Seattle's Comprehensive Plan, Toward a Sustainable Seattle" includes goals and policies about how the city will grow, based on the four core values that were identified: community, economic opportunity, social equity and environmental stewardship. The goals are to revitalize existing neighborhood business districts, making efficient use of past and future infrastructure investment, minimizing impacts on single-family neighborhood and reducing the dependency on automobiles. Even though these goals don't relate to the Urban Water Plan, it is similar in the fact that it wants to reach several goals in one plan and especially that it wants to do this in a sustainable manner.

Besides Seattle, Portney (2005) investigated lots of other cities in the United States that have sustainable city efforts. What stands out is that most of these efforts include a lot of civic engagement. As Portney (2005) points out, there is not a lot of research done in this field and more research should be needed. For example, is there any evidence that suggest that the context of sustainability mobilizes more people than other contexts? And are the cities that have fairly high levels of participation in their sustainability plans those that have regular ongoing neighborhood-based participation, such as Seattle? Are non-profit organizations such as Sustainable Seattle better able to mobilize residents than city government entities? Also, Portney (2005) points out that there is quite a lack in data when it comes to how participatory these approaches were, for example about what kinds of people were invited, over what period of time and if the participation is ongoing.

Even though there is a lack in research this study does show that implementation can start at a grassroots level. Since the UWP is at the very first stages of implementation and might not have the needed support to start at a parish governmental level, see chapter 6 and 8, it might be interesting to start with outreach on a neighborhood level.

Lessons Learned:

- Implementation of sustainable initiatives that start at a grassroots level can be successful.
- Civic engagement is wanted in most sustainable city efforts, but there is still a lack in research as to how effective this is.

3.5 Stormwater Policies in Twelve Case Studies across the United States

In 2010 EPA conducted a study towards the implementation of green infrastructure which consisted of 12 case studies⁹ around the United States, where common trends were identified with the implementation of stormwater policies to support green infrastructure (U.S. Environmental Protection Agency, 2010). The motivation for these policies are mostly innovation in stormwater management and that many of the case studies don't want spend money for one single objective and are looking more towards strategies that have multiple benefits, like the Urban Water Plan. Even though the 12 case studies vary in hydrologic regime, population and demographics, government structure and geographic and political climate, they developed and implemented similar policies, as can be seen in Table 1. Stormwater regulation is used by in every case study, followed by demonstration projects, street retrofits and a local code review and in most case studies combinations of policy approaches where used. For example, Alachua County in Florida not only passed a new stormwater ordinance for new development; they also found new funding mechanisms for capital projects, provided incentives for redevelopment and retrofit projects and developed public education and outreach programs.

Table 1: Policy methods used to support green infrastructure (U.S. Environmental Protection Agency, 2010)

| Demonstration Projects | Street Retrofits | Capital Projects | Local Code Review | Education & Outreach | Stormwater Regulation | Stormwater Fee | Fee-based incentives | Other Incentives |
|------------------------|------------------|------------------|-------------------|----------------------|-----------------------|----------------|----------------------|------------------|
| 11 | 10 | 8 | 10 | 7 | 12 | 7 | 3 | 4 |

The policies have proven to be quite effective. In Chicago these policies, which were put together in a comprehensive programs, resulted in an addition of 600,000 trees to the city's canopy and more than 4 million square feet of green roofs on 300 buildings. Also, the construction of pilot project made the construction and manufacturing industry familiar with green infrastructure materials and practices. This, together with financial incentives, increased the cost-competitiveness of some green infrastructure practices and increased implementation across the city. In the first year of new stormwater regulations, Philadelphia built out more than one square mile of low-impact development features. When fully built out, it will manage most one-inch storms, and reduce combined sewer overflow (CSO) by 25 billion gallons (95 million m³), which is estimated to save the city \$170 million. They plan to include financial incentives and assistance for retrofits and internal policies for increased use of green infrastructure to build out the last part.

Lessons Learned

- Policy methods are an effective way to increase the amount of green infrastructure.
- Most frequent used methods are stormwater regulation, demonstration projects, street retrofits and local code reviews.

⁹ These cases studies were in Alachua County, Florida; Philadelphia, Pennsylvania; Portland, Oregon; Seattle, Washington; San Jose, California; Santa Monica, California; Stafford County, Virginia; Wilsonville, Oregon.

Stakeholder Analysis

In this chapter the stakeholders that are or could be involved in the Urban Water Plan are presented. Most of these stakeholders have been interviewed to give input to the results in the following chapters. In the first paragraph an organizational chart will be presented, followed by a paragraph about the choice on interviewees and concluding with the analysis on the influence, interest and involvement of these stakeholders/interviewees.

4.1 Organizational Structure

The organizational chart shows all the departments and organizations that in some way are related to the implementation of the Urban Water Plan and are part of the chain model. The chart can be divided into three parts: parishes, regional and federal. In the following sections each of these parts will be elaborated on. Table 2 shows all the stakeholders with their responsibilities and in what part of the chain model they are active. The organizational chart and the table are based on interviews and research of documents and websites. The following paragraphs will elaborate on the different entities in the organizational chart and the table.

4.1.1 Parishes

The project area of the Greater New Orleans Urban Water Plan (UWP) contains (parts of) three different parishes: the east bank of Jefferson Parish, the east bank of Orleans Parish and St. Bernard Parish. Each of these parishes has different types of organization and a different organization structure when it comes down to identifying stakeholders for implementation of the UWP.

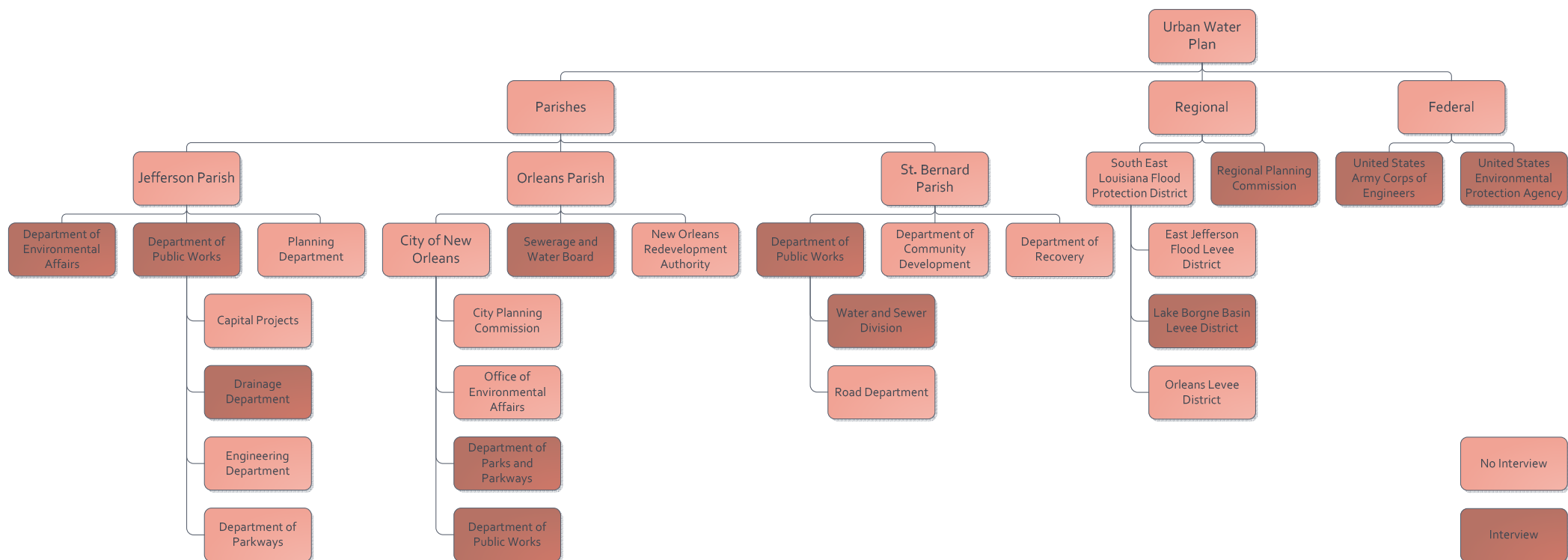


Figure 10: Organizational Chart

Jefferson Parish

Jefferson Parish probably has the simplest organizational structure when it comes to the implementation of the Urban Water Plan. All the departments are part of the government of Jefferson Parish. The Department of Public Works (DPW) is responsible for maintaining and improving the public right of way in the parish, which includes the drainage system, the streets and all big engineering projects. The three departments of the DPW that will be related to the UWP are Capital Projects, which supports other DPW departments with planning, programming and managing the engineering and construction of capital improvements; the Drainage Department, which is responsible for the drainage system including all canals and pumps; and the Engineering Department, which assist all operational departments of the DPW in matter requiring engineering design, construction supervision and project management. The other department of Jefferson Parish that should be taken into account is the Planning Department which holds responsibility over re-subdivision and rezoning of land in the public areas and maintains the Comprehensive Zoning Ordinance and Comprehensive Plan for the parish.

Orleans Parish

In Orleans Parish there are different entities to take into account besides the parish government. In parish government there is the City Planning Commission, which provides analysis and recommendations to the City Council on present and future development in the city and takes care of the Comprehensive Zoning Ordinance; the Office of Environmental Affairs, which was established to enhance and protect the environment of Orleans parish for current and future generations and improve quality of life by promoting economic development that benefits the environment; the Department of Mosquito, Termite and Rodent Control; the Department of Parks and Parkways and the DPW, which is responsible for the public right of way, including roads and the minor drainage system. The major drainage system is the responsibility of the Sewerage and Water Board (SWB) which is an entity that is set by state law. The SWB also has a Department of Environmental Affairs which holds part of the MS4 permit¹⁰ and is responsible for green infrastructure within the SWB. Another entity that should be taken into account in Orleans Parish is the New Orleans Redevelopment Authority (NORA). This entity works with public and private partners to redevelop New Orleans neighborhoods.

St. Bernard Parish

In the city government there are two departments that should be taken into account: the Department of Community Development which is responsible for planning and zoning in the parish; and the DPW, which is responsible for the public right of way. The DPW includes the Road Department and the Water and Sewer Department. The Water and Sewer Department is responsible for drinking water and sewerage, but is not responsible for the drainage system. The drainage system in St. Bernard parish falls under the jurisdiction of the Lake Borgne Basin Levee District which is part of the South-East Louisiana Flood Protection District (SLFPAE). The SLFPAE is a regional organization.

4.1.2 Regional

There are two regional organizations that need to be taken into account, the previously mentioned SLFPAE and the Regional Planning Commission (RPC). The SLFPAE designs and constructs projects that reduce the probability and risk of flooding for residents. The three levee districts (East Jefferson

¹⁰ See appendix E.

Levee District, Lake Borgne Basin Levee District and Orleans Levee District) that are in the project area of the UWP fall under this organization. The RPC is the metropolitan planning organization for six parishes including Jefferson, Orleans and St. Bernard parish. The RPC serves as a connector for the transportation funding from a federal level, where they are responsible for the prioritization of projects and the early stages of planning. The RPC also does environmental and economic development planning.

4.1.3 Federal

The United States Army Corps of Engineers (USACE) has been responsible for the Hurricane and Storm Damage Risk Reduction System, which include levee and floodwall projects in Jefferson, Orleans and St. Bernard parishes. It is now also working on the Southeast Louisiana Urban Flood Damage Reduction Projects (SELA) to reduce the risk of flood damages due to rainfall flooding in Orleans and Jefferson Parish. The United States Environmental Protection Agency's (EPA) mission is to protect human health and the environment. The EPA has been involved with the making of the UWP, is currently working on a national standard for storm water and currently working on the Urban Waters Program in New Orleans, which has similar goals to the UWP.

Table 2: Stakeholders of the Urban Water Plan

| Jurisdiction | Name | Chain Model | Responsibilities |
|---------------------|---|--|--|
| Jefferson Parish | Department of Environmental Affairs | Policy and Legislation | <ul style="list-style-type: none"> - Stormwater Management Program - Industrial Development and Research Program - Environmental complaints and inquiries |
| Jefferson Parish | Department of Public Works (oversees Capital Projects, Drainage Department, Engineering Department, Department of Parkways, and Streets Department) | Implementation and Maintenance | <ul style="list-style-type: none"> - Drainage system - Roads - Grass, shrubs, trees and flower beds in parish-owned right of ways - Planning, engineering, and construction management of capital improvements projects including SELA |
| Jefferson Parish | Capital Projects | Implementation | <ul style="list-style-type: none"> - Support other departments of DPW in planning, programming, and managing the engineering and construction of capital improvements including SELA |
| Jefferson Parish | Drainage Department | Implementation and Maintenance | <ul style="list-style-type: none"> - Major drainage system (including pumps) |
| Jefferson Parish | Engineering Department | Implementation | <ul style="list-style-type: none"> - Assist operational departments of DPW in engineering design, construction supervision and project management |
| Jefferson Parish | Department of Parkways | Implementation and Maintenance | <ul style="list-style-type: none"> - Grass, shrubs, trees and flower beds in parish-owned right of ways |
| Jefferson Parish | Streets Department | Implementation and Maintenance | <ul style="list-style-type: none"> - Roads - Street drainage |
| Jefferson Parish | Planning Department | Legislation | <ul style="list-style-type: none"> - Application for re-subdivision and rezoning of land - Maintains Comprehensive Zoning Ordinance, Subdivision Regulation and Comprehensive Plan |
| Orleans Parish | City Planning Commission | Legislation | <ul style="list-style-type: none"> - Analysis and recommendations to City Council on present and future development - Maintains Comprehensive Zoning Ordinance and the Master Plan |
| Orleans Parish | Office of Environmental Affairs | Policy, Legislation and Implementation | <ul style="list-style-type: none"> - Enhance and protect environment - Improving quality of life by promoting economic development that benefits the environment and the citizens |
| Orleans Parish | Department of Parks and Parkways | Implementation and Maintenance | <ul style="list-style-type: none"> - Managing, maintaining and developing public green space |
| Orleans Parish | Department of Public Works | Implementation and Maintenance | <ul style="list-style-type: none"> - Minor drainage system - Roads |
| Orleans Parish | Sewerage and Water Board | Implementation and Maintenance | <ul style="list-style-type: none"> - Mayor drainage system (including pumps) |
| Orleans Parish | New Orleans Redevelopment Authority | Implementation | <ul style="list-style-type: none"> - Implementation of comprehensive neighborhood revitalization plans |
| St. Bernard Parish | Department of Community Development | Legislation | <ul style="list-style-type: none"> - Applications and issuing permits for residential and commercial construction - Managing community planning efforts - Zoning |
| St. Bernard Parish | Department of Public Works (oversees Road Department and Water and Sewer Division) | Implementation and Maintenance | <ul style="list-style-type: none"> - Roads |
| St. Bernard Parish | Water and Sewer Division | Implementation and Maintenance | <ul style="list-style-type: none"> - Water quality |
| St. Bernard Parish | Road Department | Implementation and Maintenance | <ul style="list-style-type: none"> - Roads |
| St. Bernard Parish | Department of Recovery | Implementation | <ul style="list-style-type: none"> - Revitalization and restoration of neighborhoods (FEMA and Community Development Block Grant projects) |
| St. Bernard Parish | Lake Borgne Levee District | Implementation and Maintenance | <ul style="list-style-type: none"> - Drainage |
| Regional | South East Louisiana Flood Protection District | Maintenance | <ul style="list-style-type: none"> - Hurricane protection system |
| Regional | Regional Planning Commission | Implementation | <ul style="list-style-type: none"> - Roads |
| Federal | United States Army Corps of Engineers | Implementation | <ul style="list-style-type: none"> - Drainage (in the form of SELA projects) |
| Federal | United States Environmental Protection Agency | Policy and Legislation | <ul style="list-style-type: none"> - Clean Water Act |

4.2 Interviews

Most of the interviews that have been conducted are with stakeholders that are represented in the organizational chart. The first objectives were to interview stakeholders in all of the parishes and interview stakeholders that had responsibilities in the components of the chain model. The DPW has a role in the implementation of the Urban Water Plan in all three parishes. Therefore these were all interviewed. In Jefferson parish this interview was done together with the Drainage Department which is a sub-department of the DPW. A choice was made to not only do one interview a parish. In Jefferson parish the Department of Environmental Affairs was interviewed, because several federal programs are their responsibility. In St. Bernard the Water & Sewer Division was interviewed, since the interviewee was also responsible for Capital Projects and therefore it was assumed that he would have experience in implementing big projects within the parish. All of these departments have responsibilities in different aspects of this project. The interviewees were selected base on a snowballing process. The first were identified by looking up documents and articles and the following interviews were based on snowballing within the first interviews, by asking the interviewees who they considered important for the implementation of the Urban Water Plan.

The only levee district that was interviewed was the Lake Borgne Basin Levee District, since this entity is responsible for the drainage system in St. Bernard parish. The other regional entity that has some jurisdiction over aspects of the UWP is the Regional Planning Commission. Another reason to interview this organization is the fact that they are a regional entity, so they have experiences with parishes working together, and identify constraints that organizations at a parish level do not foresee.

The federal organizations that were interviewed are EPA, because they are the agency which holds legislation and policy with regards to storm water, and the USACE, since they are currently involved in another drainage project in the project area. The interview was conducted with an interviewee that worked for both organizations.

Besides these 12 interviews there were 3 other interviews conducted – with the Department of Mosquito, Termite and Rodent Control, with Arcadis and with Thomas Strategies, LLT. The first mentioned was interviewed because of the concerns of mosquitoes when implementing this plan that has been expressed by other interviewees as well as media and general public. The latter two interviews were done because the interviewees were considered experts to the area, have experience with implementation of projects in the area and have experience with implementation of similar projects.

The interviews were conducted as semi-open interviews. The structure of the interview and the relevant topics were predefined, but there was room to ask more questions if necessary. The prepared questions can be found in Appendix C.

4.3 Power and Interest

In this part of the stakeholder analysis the involvement of stakeholders so far will be evaluated. The analysis is based on the input given during the interviews by the stakeholders and will therefore only be done on the stakeholders that were interviewed.

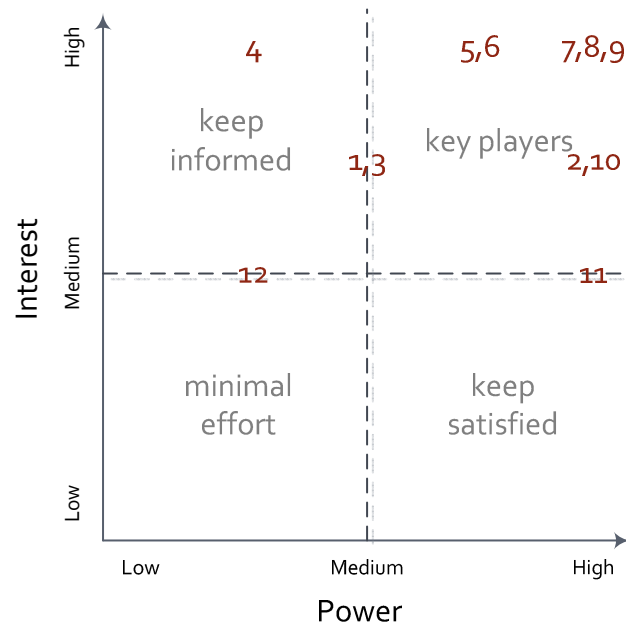


Figure 11: Power/Interest Matrix of the Stakeholders of the Urban Water Plan

In the power/interest matrix in Figure 11 it can be seen that most of the interviewed stakeholders can be considered key players. The ones that are not key players are the Water and Sewer Division of St. Bernard Parish and the Mosquito, Rodent and Termite Control of the City of New Orleans, who do not have direct responsibilities towards the plan. As can be seen in Table 3 on page 41 they also don't expect the plan to impact them a lot. If the UWP is implemented correctly it will only impact them positively, reducing mosquito breeding (see paragraph 5.2) and improving the water quality. What also can be seen in the figure is that in general the Orleans Parish officials are more interested in the plan than officials from Jefferson and St. Bernard Parish. This could suggest that the latter two parishes should be involved more in the process.

The stakeholders were involved in the design of the Urban Water Plan in the form of workshops, committees and as consultants. Only two of the interviewed stakeholders were not involved in the design process of the Urban Water Plan of which one of them – the Department of Parks and Parkways of the City of New Orleans – can be considered a key player, which shows that they should have been involved. There are also stakeholders that were involved, but would have liked to be involved more. Most of them would have liked to be involved more, at an earlier phase so they could have had more of an influence on the plan. On the other hand a lot of the stakeholders mention that for the stage where the Urban Water Plan is now, the level of involvement was appropriate.

The degree of involvement shows how the stakeholders should be involved. This is based on the responsibilities the stakeholders have with regards to the UWP. If they have responsibilities that have are directly influenced by the Urban Water Plan, they are co-working. Most of the stakeholders are co-operating; these stakeholders need to work on the UWP in order for it to be implemented.

There are two stakeholders that are co-thinking, the Departments of Environmental Affairs of the Sewerage and Water Board and Jefferson Parish. These are stakeholders of which consult is needed with regards to the Urban Water Plan. This is based on the fact that these departments have responsibilities towards the Urban Water Plan, but these are mostly advisory. Two stakeholders are co-knowing, meaning that these stakeholders will not be playing an active role in the project but needs to be updated on the project. Their responsibilities are only indirectly changed with regards to the UWP. The interviewees that are not labeled as stakeholders, the Regional Planning Commission, the U.S. Army Corps of Engineers, and the U.S. Environmental Protection Agency, but are part of the organizational structure currently have a co-knowing role as well. This might change if one of these is involved in implementing some of the projects, but they are not necessary for moving the UWP forward. Also this part of the analysis shows that the Department of Parks and Parkways of the City of New Orleans should be more involved in the implementation process of the UWP.

The main goals of the UWP are to increase safety with regards to floods due to rainfall and subsidence, increase the quality of live, and provide economic opportunity. All of the stakeholders that have goals which are influenced by the implementation of the UWP can relate to these goals and find them similar to the goals of their department or organization, so they don't oppose of the plan.

Table 3: Stakeholders Analysis

| Stakeholders | Characteristics | | Involvement | | | Impact |
|--|---------------------|-----------------------|-------------------------------------|--------------------|-----------------------|--------------------------|
| | Type of Stakeholder | Role of Stakeholder | Involvement with design of the plan | Enough involvement | Degree of involvement | Impact of issue on actor |
| Department of Environmental Affairs of Jefferson Parish | Local Government | Consultant | Involved | No | Co-thinking | Medium |
| Department of Public Works of Jefferson Parish | Local Government | Implementer/executive | Involved | Yes | Co-operating | Medium |
| Drainage Department of Jefferson Parish | Local Government | Implementer/executive | Involved | Yes | Co-operating | Medium |
| Mosquito, Rodent and Termite Control of the City of New Orleans | Local Government | Consultant | Not involved | No | Co-knowing | Low-medium |
| Department of Parks and Parkways of the City of New Orleans | Local Government | Implementer/executive | Not involved | No | Co-operating | High |
| Department of Public Works of the City of New Orleans | Local Government | Implementer/executive | Involved | Yes | Co-operating | High |
| Department of Environmental Affairs of the Sewerage and Water Board of New Orleans | Local Authority | Implementer/executive | Involved | Yes | Co-thinking | High |
| Executive Directors Office of the Sewerage & Water Board of New Orleans | Local Authority | Decision maker | Involved | No | Co-operating | High |
| General Superintendents Office of the Sewerage and Water Board of New Orleans | Local Authority | Implementer/executive | Involved | Yes | Co-operating | High |
| Lake Borgne Basin Levee District | Local Authority | Implementer/executive | Involved | Yes | Co-operating | Medium |
| Department of Public Works of St. Bernard Parish | Local Government | Implementer/executive | Involved | No | Co-operating | Medium-high |
| Water and Sewer Division of St. Bernard Parish | Local Government | Implementer/executive | Involved | Yes | Co-knowing | Low |

SWOT Analysis

In this chapter the SWOT analysis will be discussed. In the first paragraph the results will be presented. The interviewees were asked what the strengths and weaknesses were of the Urban Water Plan and also what the opportunities and threats they foresee for their organization. The last paragraph shows the discussion towards the results, explaining the outcomes of the analysis and what can be done with these results.

5.1 Results

Table 4 shows the results of the SWOT analysis. The results are clustered in themes, which are all explained in the following sections.

Table 4: Results of the SWOT analysis

| Strengths (15) | | Weaknesses (15) | |
|--------------------------------|----|--|---|
| Approach and Principals | 12 | Funding | 5 |
| Projects and Technical aspects | 8 | Lack of Technical Data | 5 |
| Outreach and Communication | 6 | Lack of West Bank | 2 |
| Benefits for organizations | 3 | Outreach and Buy-in | 3 |
| Support | 3 | Too conceptual | 3 |
| Problem statement | 1 | Still on political subdivision basis | 1 |
| | | Very big projects | 1 |
| Opportunities (8) | | Threats (8) | |
| Funding and Cost Savings | 4 | Costs | 1 |
| Community outreach | 2 | Creates enormous expectation for my organization | 1 |
| Build knowledge | 2 | Mosquito breeding sites | 1 |
| Small scale projects | 2 | Too much work for my organization | 1 |
| Change mindset | 1 | | |

5.1.1 Strengths

Approach and Principals

The biggest strengths of the Urban Water Plan are the approach and the principals on which it is based on. The most heard comment was that it is comprehensive and based on good environmental planning, good water management and makes use of the strengths and advantages of New Orleans and takes the geography well into account.

It is believed that the plan can increase the quality of life and increase the property value with a different approach and that there is a real need to re-invent the city. The idea that the general public does not have to live with yearly floods and that it will reduce the work load on the drainage system has also been mentioned as a big strength.

To take a regional approach on this is also very much needed.

Projects and Technical aspects

The interviewees like the fact that the projects can be done independent from each other, so that you don't need all of the funding to get started. The projects were described as good, sound, easy, small and ready.

As for the technical aspects, the projects are commented on the approach for the canals, the increase of green space, better water quality and that it will probably prevent mosquito breeding. Also controlling subsidence and reducing runoff are seen as strengths.

Outreach and Communication

The Urban Water Plan got the conversation on a new approach started and going. It got the word out about a possibility of a resilient community and was able to create a lot of energy about it.

It brought together stakeholders and entities that normally don't meet and discuss stormwater management.

It also made it easier for some entities to get buy-in for green infrastructure and brought awareness to role of certain departments and organizations.

Benefits for organizations

There were also other benefits for organizations besides getting more buy-in for green infrastructure and bringing awareness to their role. For some organizations it gave direction and certain vision. It also provided the organizations with a lot of new tools to use for better water management practices. It was also mentioned that it might be easier to get funding, because it is difficult to get funding for grey infrastructure that is usually under the ground, whereas these projects are things people can see, feel and touch.

Support

Some of the interviewees liked the fact that it is backed up by a lot of elected officials, from all different levels of government.

Problem statement

The problem statement clearly shows the threat from rain water and subsidence to the long term sustainability of the city and its community. It really shows well that in addition to coastal wetlands loss and hurricanes, rainfall is an equal threat as well as subsidence.

5.1.2 Weaknesses

Funding

There is a lot of investment costs needed to implement the Urban Water Plan and there is no clear idea on how to create this funding.

Lack of technical data

Some of the interviewees are not sure some of the projects will have the wanted effects because they haven't seen the supporting data to prove it. It has not been backed up by any engineering studies. Especially on the issue of subsidence it is not clear if these solutions will really help the problem and if the problem is really caused by bad groundwater management.

Lack of West Bank

A big part of Jefferson parish and some parts of Orleans parish are on the West Bank. A couple of interviewees mentioned that it is a missed opportunity to not include the West Bank, because there is less developed area so it might be much easier to implement the Urban Water Plan. It is also an area that is prone to floods and has issues with subsidence.

Outreach and buy-in

Even though this was also a strength, some of the interviewees believe that the outreach and buy-in to the elected officials and community was not enough and should have been more. Another weakness that will make buy-in more difficult is that it is not a plan that is developed by the city governments, but by a non-governmental organization, who doesn't have the power implement the plan.

Too conceptual

A part that is missing in the Urban Water Plan is how to move from conceptual to action. It might have been the scope of the plan to be conceptual, but for some interviewees it was not clear if this was just a vision on stormwater management for New Orleans or if it can be really implemented.

Still on political subdivision basis

There was an opportunity to try and truly regionalize water management or maybe just an element of the water management scheme, like for example subsurface drainage, but these projects are still on a political subdivision basis.

Very big projects

The projects are too big and therefore too costly find enough funding and implement. It might therefore be too difficult to get the needed buy-in for the projects.

5.1.3 Opportunities

Funding and cost savings

There is now an opportunity to find funding for green infrastructure with a plan like the Urban Water Plan. It also may help to find a way to finance some maintenance programs and make it easier for the community to understand the differences in costs of green and grey infrastructure, where green infrastructure has less investment costs but higher maintenance costs than grey infrastructure. It might even come with some cost savings with compared to the infrastructure that is currently in place.

Community outreach

There are some great ideas and opportunities for community outreach and being able for the general public to understand some of these stormwater management concepts when implementing some of these projects. The demonstration projects could really be an opportunity to engage the community in this dialog of a new approach to stormwater management and groundwater monitoring.

Build knowledge

New Orleans has the opportunity to build knowledge about stormwater management and subsidence control that is going to be needed in the rest of the country. This could be a field in which New Orleans could become one of the countries experts, just like the Netherlands has done.

Small scale projects

The ideas of the Urban Water Plan can be done in projects on a smaller scale, a scale that allows the community to engage with and to learn about what works and what doesn't work in New Orleans.

Change mindset

The Urban Water Plan provides an opportunity for organizations and the city governments to think differently about water management and that there are other possibilities for dealing with the addressed issues.

5.1.4 Threats

Costs

The investment costs for the Urban Water Plan are huge. There is a very real possibility that some entities will not be able to come up with the money.

Creates enormous expectations for my organization

The Urban Water Plan has a lot of good ideas that the general public would like. On the other hand that might create enormous expectations for some of the organizations that are responsible for stormwater management, expectations that might be very difficult to meet.

Mosquito breeding sites

If some of the projects are not implemented well or if there is a lack in maintenance there is a chance that some sites like bioswales and rain gardens, can turn into mosquito breeding sites.

Too much work for my organization

For some of the organizations the workload will increase if all or part of the Urban Water Plan is implemented, but without the necessary additional funding or staff there is a chance these organization have more work than they can handle. This could result in a lack of maintenance and therefore failure of some of these projects in the Urban Water Plan.

5.2 Discussion

First can be noted that there are more strengths and opportunities mentioned than weaknesses and threats. Overall the interviewees can be considered positive about the plan, which certainly would make it easier to implement.

In literature a SWOT analysis is used to offset the strengths against the weaknesses, but the strengths that are mentioned are all on the plan as a vision, whereas the weaknesses are more based

on the plan if it were to be implemented. This makes it more difficult to compare the strengths and weaknesses.

As mentioned in paragraph 2.3 on the SWOT analysis, threats should be turned into opportunities to make implementation easier. Two of the mentioned threats, mosquito breeding sites and costs, are also mentioned in other parts of the SWOT analysis and will be discussed later on. The threat of creating enormous expectations for the organizations that will be implementing the Urban Water Plan can also be seen as an opportunity. In general the general public is very critical of what is done with their tax-money, but as one interviewee expressed it: "They especially like it when they see tax money going to green spaces and flood reduction". It is a good opportunity to show the general public what is done with tax-money and how water is managed. The last threat that was mentioned was that it could be more work than a department can handle in terms of personnel. This is not a threat that can easily be converted to an opportunity, but this is certainly an aspect that should be taken into account when moving forward.

Some of the aspects that are mentioned are both a strength and a weakness or an opportunity and a threat. For example, a strength of the projects of the Urban Water Plan is that they are small enough to be easily implemented, whereas they are also too big and therefore need too much funding to implement. There is an opportunity to find funding with a plan like the Urban Water Plan, but on the other hand, the upfront costs are also considered a threat. These will be discussed in the following sections.

Mosquitoes

The potential to prevent mosquito has been identified as a strength, see Projects and Technical Aspects. On the other hand the potential of increasing the amount of breeding sights has also been identified as a threat. There is a truth to both sides of the story. Due to the subtropical climate, New Orleans has a long history with vector-borne diseases. New Orleans was the last city in the United States to have an epidemic outbreak of the Yellow Fever in 1905 (Patterson, 1992), there is a history of dengue fever outbreaks as well (Brathwaite Dick, San Martin, Montoya, del Diego, Zambrano, & Dayan, 2012), every year there are couple cases of the West Nile Virus (Copeland, 2012) and the authorities are worried dengue will return again (Micheals, 2013). Potential breeding sites for mosquitoes are puddles with standing water. To prevent mosquito's from breeding in retention areas in general a rule is applied that a retention area should be emptied within 48 hours. The UWP is introducing a lot more place for water to be stagnant and infiltrate into the ground in the project area in the form of bioswales, rain gardens and retention areas. If these are not engineered well or if they are not maintained properly there is a chance this 48-hour-rule will not be met. On the other hand it decreases the amount of mosquito breeding sites. In general the rule to prevent mosquito breeding sites is to keep wet places wet and dry places dry. In the current drainage system there are a lot of canals that are kept empty when there is no need to distribute water to the pump station and are filled up during and after a big rainfall event. Because these canals are not maintained properly, it is difficult to empty them, and puddles are left behind which are ideal breeding sites. By maintaining a water level in these canals at all times and circulating the water, the mosquitoes will not be able to breed in them.

Size of the projects

The size of the projects is both a strength and a weakness. The size of the projects is considered too big to find the needed funding. The size of the pilot projects that are currently done by the parishes on green infrastructure are considerably smaller and cost less money. For example the pilot projects that the Sewerage and Water Board want to set out for the MS4 Permit cost a half million dollars, where the demonstration projects mentioned in the Urban Water Plan will cost 10 to 20 million dollars each. The scale of these demonstration projects is much larger and therefore more of the effects of these types of projects can be seen on for example the amount of water that ends up in the drainage system. On the other hand there is the possibility to do only small scale retrofits instead of implementing the whole demonstration project all at once, using only the easiest strategies, or doing the projects on a smaller scale. This was also identified as an opportunity by some interviewees.

Funding

Funding is the most mentioned weakness, is mentioned as a threat, but is also an opportunity according to some interviewees. There is no denying that there is a current lack of funding for the plan, and a strategy needs to be made to come up with funding. But there now is an opportunity to look for funding for green infrastructure and doing it differently, but maintenance of green infrastructure has a small likelihood of being cheaper than maintenance of grey infrastructure, as was mentioned by an interviewee as an opportunity. The funding opportunities that were mentioned by most interviewees reflected on now being able to pay for a lack in maintenance that their organizations already have, which only shows that there already is a lack in funding for the current infrastructure, which is a problem that is much bigger than the scope of the UWP and this thesis.

Support by the Politicians

This theme is both a strength and a weakness and both are probably right. In September the UWP was presented to a large crowd of stakeholders, media and other interested people. During this presentation the parish presidents of St. Bernard Parish and Jefferson Parish and the deputy-mayor of the city of New Orleans showed their support towards the plan. However, months later there are no actual movements made towards implementing the plan, and the organizations that should taking steps in implementing the UWP, haven't done anything, which suggest no orders have been made from the elected officials.

Constraints

In this chapter the constraints which have been identified by the interviewees will be shown and described. Table 5, on the next page, shows the constraints which were identified during the interviews.

6.1 Chain Model

The constraints in Table 5 are sorted according to the chain model. The chain model was originally used as a tool to develop policy. In this thesis it is used as a tool to implement a plan that already has been developed. This gives another initial obstacle that is not realized in the current chain model, namely the fact that policy-makers have not yet adopted the plan as to wanting to implement it. This initial hurdle would have been overcome if the plan was developed by policy-makers, as is usually the case when using the chain model, but here it is not the case. Therefore there is another component that should be taken into consideration, politics. The plan first has to go through politics before it will become policy. This specific part comes with its own constraints which should be overcome before the plan can be implemented. Another different aspect from the chain model is that New Orleans has no vision stated with regards to the storm water management or green infrastructure. Generally when using the chain model, first a vision is proposed or is already in place to continue with policy and other parts of the chain model.

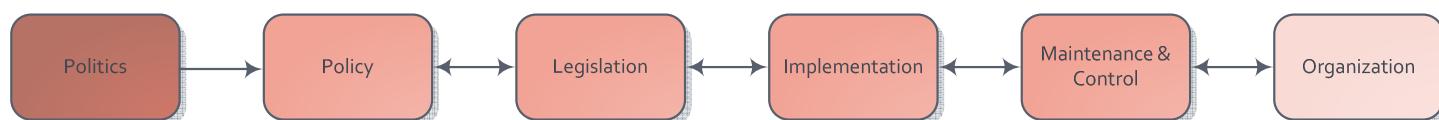


Figure 12: Chain Model with the Addition of Politics

Table 5: Constraints for Implementation of the Urban Water Plan

| | Department of Environmental Affairs of Jefferson Parish | DPW of Jefferson Parish | Mosquito, Rodent and Termite Control of Orleans Parish | Department of Parks and Parkways of Orleans Parish | Department of Public Works of Orleans Parish | Department of Environmental Affairs of the SWB of Orleans Parish | Executive Directors Office of the SWB of Orleans Parish | General Superintendents Office of the SWB of Orleans Parish | Lake Borgne Basin Levee District | Department of Public Works of St. Bernard Parish | Water and Sewer Division of St. Bernard Parish | U.S. Environmental Protection Agency | Regional Planning Committee | Arcadis | Thomas Strategies, LLT. |
|---|---|-------------------------|--|--|--|--|---|---|----------------------------------|--|--|--------------------------------------|-----------------------------|---------|-------------------------|
| Politics | | | | | | | | | | | | | | | |
| Get buy-in from the people from the general public | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | | |
| Get buy-in from civic groups in neighborhoods | ✓ | | | | | ✓ | | | | | | | | | |
| Get buy-in from the public officials | ✓ | | | | ✓ | ✓ | | | ✓ | | | | | | |
| Policy | | | | | | | | | | | | | | | |
| Different policies of entities or parishes | | | | | | | | | | | | ✓ | ✓ | | |
| Lack in policy | | | | | | | | ✓ | | | | | | | ✓ |
| Commitment to policy (enforcement) | ✓ | | | | | | | ✓ | | | | | | | |
| Legislation | | | | | | | | | | | | | | | |
| Lack in legislation | ✓ | ✓ | | | | ✓ | | | | | | ✓ | | | ✓ |
| Implementation | | | | | | | | | | | | | | | |
| Less talk, more action | | | | | | | | | | ✓ | | | | | ✓ |
| Problems with projects areas: on private property; very developed/availability of land; underground utilities | ✓ | ✓ | | ✓ | | ✓ | | | ✓ | | | ✓ | | | |
| Health and safety concerns: access to water for kids; pollutants in the water; mosquito breeding | | ✓ | ✓ | | ✓ | | | | | | | ✓ | | | |
| Maintenance and Control | | | | | | | | | | | | | | | |
| Responsibility of maintenance and control | | | | ✓ | | ✓ | ✓ | ✓ | | | | | | ✓ | |
| Lack of maintenance | ✓ | | ✓ | ✓ | ✓ | | | | | | | ✓ | | | |
| More maintenance needed | | | | | | | ✓ | | | | | ✓ | | | |
| Practical issues: getting material on the right location; no mosquito problem | | ✓ | | | | | | ✓ | | | | | | | |
| Organization | | | | | | | | | | | | | | | |
| Responsibility of the different aspects of the UWP | | | | | | ✓ | ✓ | ✓ | | | | ✓ | | | |
| Structural changes within the city due to change of mayor | | | | | ✓ | | | ✓ | | | | | | | |
| Fragmentation (local/regional) | ✓ | | ✓ | | | ✓ | | ✓ | | | | ✓ | | | |
| Coordination | | | | ✓ | | ✓ | | ✓ | | | | | ✓ | | ✓ |
| Regional plan, local responsibility | ✓ | | | | | ✓ | | | | | | | | | |
| Cooperation and agreement between entities and parishes | ✓ | | ✓ | | | | | ✓ | | ✓ | | | ✓ | | |
| Other | | | | | | | | | | | | | | | |
| Funding | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Paradigm shift | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

In literature and documentation on green infrastructure and integrated water management constraints towards implementation can also be found. A few of them have been mentioned in paragraph 1.2.1, which are uncoordinated institutional framework, limits of regulatory framework and unclear, fragmented roles and responsibilities. A study by the U.S. Environmental Protection Agency (EPA) stormwater policies (EPA Office of Wetlands, Oceans and Watersheds, 2010) identified the following constraints: funding, lack of political support/leadership, resistance to change, coordination of multiple stakeholders and partners, legislative action, conflicting regulations, need for technical information and training, misunderstanding about land use issues and cost concerns. The National Research Council conducted a study towards urban stormwater management in the United States and found the following challenges for implementation: funding and costs; long-term maintenance; lack of design guidance and lack of training; different standards in different jurisdictions within the same watershed; and safety and aesthetic concerns (National Research Council, 2009). Comparing these constraints with Table 5 show that these are quite similar. The only difference is that the interviewees identify buy-in from the public as being very important, however this is not mentioned in the previously mentioned literature and studies.

In the next paragraphs the results for each component of the chain model will be explained and discussed.

6.1.1 Politics

6.1.1.1 Results

In the project area flood control is incorporated in local politics. According to some of the interviewees it is too much incorporated with local politics. The reason for this is that most entities serve a board, which mostly consists of elected officials who gain their votes from the general public.

Politics is all about getting buy-in from public officials and the general public. They need to believe the Urban Water Plan is necessary before it can be implemented. Some interviewees believe that the change in mindset is already moving in the right direction. Buy-in from the public might not be that difficult, because never before was there such an opportunity, momentum and funding. A lot of people have made the decision to either come or come back after Katrina and are willing to invest in it. Yet, there are still some constraints to overcome.

Get buy-in from public officials

Getting buy-in from the neighborhoods and the general public has been identified as a constraint by most of the interviewees, as well as getting buy-in from the public officials. These constraints are linked because before the public officials or local politicians will buy-in to this plan, or will even consider the UWP, the general public needs to buy-in on the plan, since the political buy-in depends on the public buy-in. Elected officials have to go before public and eventually face public election on a regular election cycle, so they are sensitive to what the general public thinks and about receiving complaints from them. Therefore citizen advocacy must be created in order for elected officials to raise taxes or fees as additional funding for the Urban Water Plan.

Another constraint that comes with getting buy-in from the public officials is that it has to be given priority. The problem right now is that it is too much on the long term to be a priority because most stakeholders are focused on the near term. This has different causes. One of them is that other issues have a higher priority, for example water quality. In St. Bernard they are currently dealing

with the amoeba parasite¹¹ in the drinking water system. On the other hand it is quite difficult to already be looking forward, since Katrina is not that far in the past. Who is going to be the first one to say, that you have to look forward and stop looking at the past. The general public might still believe that there are still post-Katrina issues that first have to be dealt with.

Get buy-in from the general public

A big part of getting the public buy-in starts with outreach. The general public needs to be comfortable with the idea of water around them and get used to a new kind of esthetics. And people have to be made aware of the fact of the positive effects of the Urban Water Plan and be aware of the fact that there is an opportunity to not live with yearly floods caused by rainfall events. Outreach is also very important, because the general public is very resistant to change. A part of the resistance can be addressed to the fact that it has been a long road for a lot of people. The people that have stayed after Katrina have invested a lot; they have come back and reestablished and are now afraid and cautious about changes.

Get buy-in from civic groups in the neighborhood

Neighborhood associations have to be part of the education process. They are going to make it or break it, because they are the leadership in the communities. After Katrina the government was either very unapparent or fractionated for a period of time so when neighborhoods were trying to rebuild itself they became very strong. There is a lot of development and 'building on neighbors' focused areas that weren't there before and therefore if you don't get buy-in from the neighborhoods it will be virtually impossible to implement anything. Another part is also that it is quite difficult to educate the total population of the project area so it might be much easier to start at a neighborhood association level. It will take commitment on the part of the appointed officials to develop that information at a level that is understandable for the public to buy in to and go to all the civic groups meetings and do the presentations.

6.1.1.2 Discussion

Politics can also be referred to as agenda setting, an area where a lot of research has been done on in the past. Agenda setting can be seen as the process by which problem and alternative solutions gain or lose public and government attention (Birkland, Agenda Setting in Public Policy, 2007) or in other words agenda setting is the process in which a solution for a problem is given priority by the political leaders to move forward in the chain model. According to (Haeuber, 1996) these agendas are a function of three interrelated streams of events and processes. These streams correlate very well with the constraints that have been found:

- Problems: the set of issues in a particular public area that come to capture the attention of those in and around government at any time, which can be considered as the buy-in of the public officials;
- Politics: trends and events in the overall political environment, such as swings in national mood or public opinion, election results, changes of administration, shifts in partisan or ideological distributions in Congress, or interest groups, which can partly be considered the buy-in of the general public and the neighborhood associations;
- Policy articulation: a process involving gradual accumulation of knowledge and perspectives among specialists in a policy area, and the resulting generation of policy proposals of those

¹¹ More about the amoeba parasite in Appendix E.

specialists. This does not correlate with a constraint, but can be seen as the development of the Urban Water Plan and the buy-in of the stakeholders.

Get buy-in from public officials

Buy-in from the public officials can be split up into two different agenda's: the governmental agenda and the decision agenda. The governmental agenda is the set of subjects that are paid close attention by those in and around the government. The decision agenda is the subset of subjects within the governmental agenda that are up for decisive action, for example a passage of legislation. So an issue can be on the governmental agenda but might never make it on the decision agenda (Haeuber, 1996). At the moment the Urban Water Plan can be viewed as something that is on the governmental agenda, but not on the decision agenda. For this to happen an opening of a so-called policy window is needed. Policy windows are opportunities of action, allowing one to push certain conceptions of problems or solutions to them. They open when problem, policy and political streams merge. Policy windows are critical events, as they are relatively infrequent, short-lived, and usually the result of a fortuitous combination of circumstances. These windows generally open due to changes in the problem or political streams, or both. For example in the case of environmental management a policy window opened during the first two years of the Clinton administration as a consequence of three factors: the increasing number and visibility of environmental crisis; changes in the political stream; and perceived and real shortcomings in existing natural resource management policies, supported by the apparent attractiveness of environmental management as an alternative (Haeuber, 1996). The notion by some interviewees that it might be too close to hurricane Katrina is also dangerous for these policy windows, since now there is the opportunity, a momentum as one interviewee described, to do such things, which wasn't there before Katrina. A policy window can be created, but it can also be in the form of a focusing event, a sudden attention-grabbing event, such as a hurricane or an extreme rainfall event. These focusing events can be used to advance an issue on the agenda and can serve as a potential trigger for policy change (Birkland, Focusing Events, Mobilization, and Agenda Setting, 1998). One of the interviewees also expressed that it might be crucial for the Urban Water Plan what type of event happens next. In the past flooding was always associated with rainfall events, but after Hurricanes Katrina, Rita and Isaac this is not the case anymore. If the next flooding event is caused by a rainfall event, the purpose of the plan can be shown, if it will be a hurricane where the new hurricane protection system protects the system, the public might not see the necessity of the plan.

A more difficult constraint of the plan will be fact that it has a time-span of about 50 years. For elected officials this is not the kind of project that can be sold to the public as being done in their term. Elected officials can at most be seated for 2 terms of 4 years. Another constraint that might arise with this is that in those 50 years there might be different opinions of these elected officials on the Urban Water Plan. One way of accounting for that is by making it policy or legislation as will be discussed in the next paragraphs.

Buy-in from the general public

A lot of attention during the interviews was raised to the fact that buy-in of the public is needed, but how much influence does the public actually have on policies and agenda setting? And do they need to be more informed to buy-in to these types of solutions? There has been some research on the links between education and behavior change in the field of water recycling, which can be considered somewhat similar to the field of urban drainage. These surveys state that people with a

higher level of education are more supportive. However, since the relationship between people's level of knowledge, perceptions and acceptance on these issues is fairly complex and the fact that not a lot of research has been done on this topic in the field of water recycling, makes it fairly difficult to draw conclusions (Stenekes, Colebatch, Waite, & Ashbolt, 2006). In the field of new policies and agenda setting in green infrastructure and urban drainage hardly any research was found. This is also confirmed in the study of Portney (2005), which was discussed in paragraph 3.4.

However, in order to see how well the general public was informed on topics such as water management, urban drainage and subsidence, all topics in the Urban Water Plan, and how open they are towards new plans like these, a small survey was conducted in the Lakeview neighborhood in Orleans parish, in which 19 inhabitants were asked to fill in a survey which can be viewed in Appendix D. This survey is intended to give some idea of how the general public thinks, since there were no big differences on how the surveys were filled out. The results can be seen in Table 6. The first thing that stands out is the fact that everybody had something to say about stormwater management, but when it came to subsidence, a lot didn't know what it was. The responses to both were mostly negative and issues that were not taken well care of. Hardly any participants knew about the Urban Water Plan. However, even though almost all of the principles and strategies needed to be explained, most of the participants were positive towards them. This shows that getting buy-in from the public might not be a big constraint after all. This has also been expressed by one of the interviewees, who stated that citizens in general are on board once they see that something is being done with taxpayers dollars, especially when it goes to green space and projects that reduce floods.

Table 6: General Public Survey on the Urban Water Plan

| | | |
|--|-----------------------------|------|
| Number of participants | | 19 |
| Age (average) | | 49 |
| Gender (M/F) | | 12/7 |
| Knows about water management | | 52% |
| Knows about subsidence | | 47% |
| Knows about stormwater management | | 100% |
| Knows about the Urban Water Plan | | 10% |
| Supportive of the principles¹² (choice of 1 to 5, with 5 being most supportive) | Live with water | 3,7 |
| | Slow and store | 4,3 |
| | Circulate and recharge | 4,4 |
| | Work with nature | 4,7 |
| | Design for adaption | 3,9 |
| | Work together | 3,9 |
| Supportive of strategies¹³ (choice of 1 to 5, with 5 being most supportive) | Pervious paving | 4,1 |
| | Bioretention & infiltration | 4,7 |
| | Plants | 4,8 |
| | Subsurface storage | 4,3 |
| | Exfiltration | 4,4 |

¹² More information on the principles can be found in Appendix B.

¹³ More information on the strategies can be found in Appendix B.

The stakeholders were also asked to rank the same principles. These results are seen in Table 7. In general, it should be noted that all principles were ranked quite high, for both general public and stakeholders. However the results do show that the general public has different thoughts about what the more important principles are in the plan. Living with water is ranked lowest for the general public and highest by the stakeholders. This could be addressed towards the general public being opposed of water due to mosquitoes and safety issues. On the other hand the general public liked the idea of circulate and recharge a lot better, which seems to contradict one another. This suggests more education is needed. Both general public and stakeholders liked the principle of working with nature.

Table 7: Comparison of Ranking of the Strategies by General Public and Stakeholders

| General Public | | Stakeholders | |
|----------------|------------------------|--------------|------------------------|
| 1 | Work with Nature | 1 | Live with Water |
| 2 | Circulate and Recharge | 2 | Work with Nature |
| 3 | Slow and Store | 3 | Work Together |
| 4 | Design for Adaption | 4 | Slow and Store |
| | Work Together | 5 | Design for Adaption |
| 6 | Live with Water | 6 | Circulate and Recharge |

Also it should be noted that trying to get a lot of buy-in from the general public can also kill a project, as one interviewee expressed it. Right after Katrina the local government was trying to get a high level of citizen buy-in to projects, but eventually these projects never got implemented, because it was impossible to get the high level of consensus that they wanted. It is impossible to get everybody's buy-in in a city of more than 300 thousand citizens, since there are only a handful of people that will participate in meetings and there is only so much an entity can do to get buy-in. Therefore the question should be asked, how much buy-in do you actually need, and is it not more about not getting people to be opposed of the plan.

Buy-in from neighborhood associations

After hurricane Katrina the neighborhood associations have become a lot more influential. As some of the interviewees expressed, the lack of governmental help after Katrina forced neighborhoods to rebuild themselves. One year after Katrina the planning process that was supposed to be done by city and state had barely even begun, so neighborhoods had started for themselves (Kates, Colten, Laska, & Leatherman, 2006). Other community groups have targeted local rebuilding issues and taken on citywide and regional problems like affordable housing, wetland restoration and future storm protection. This grassroots approach is what many people are hoping for, due to the lack of confidence in government, but it will not lead to citywide policy as well as hard, unpopular decisions that might be necessary for the benefit of the whole city need to be made, which can't be done on a grassroots, neighborhood level (Nelson, Ehrenfeucht, & Laska, 2007). Nevertheless, these neighborhood associations and community groups have become quite powerful and can't be forgotten in the process. As one of the interviewees expressed, 'they can make or break projects'.

Media

The influence of the media on this process is an important aspect that is found in literature on agenda-setting (Cook, et al., 1983; Kim, Scheufele, & Shanahan, 2002). The media coverage on the Urban Water Plan has been quite excessive the first couple of days after the release of the Urban

Water Plan. More than 300 national publications posted the GNO Inc. press release and it generated significant local media coverage. In Table 8 a few of the local newspaper articles can be seen. Most of the published articles focus on the new approach, the amount of money the plan is going to cost and the support that the Urban Water Plan received from the public officials who were at the release of the plan. The articles were neither positive, nor negative, leaving it to the public to decide whether to oppose it. Also all the articles were quite short and do not go into much detail of the technicalities of the plan and why it would work. As one interviewee expressed it: 'The media hasn't yet captured the excitement that was in that room when these issues were discussed.' All articles talk about a reduction of flooding, but none of the articles really capture the essence of what the real benefits are for the general public, namely that it could potentially mean that certain neighborhoods don't have to experience yearly floods and that it has the potential of decreasing the amount of insurance citizens are currently paying for their houses.

Table 8: Media on the Urban Water Plan

| Article Title | Newspaper/TV station |
|---|--------------------------|
| Water in New Orleans: pushing a new approach to old problem | The Times Picayune |
| Urban Water Plan could change the way metro area looks at major rain events | WWLTV |
| New Urban Water Plan promises better rain drainage control, beautification | WWLTV |
| Urban Water Plan unveiled | Fox 8 Live |
| Local leaders spill on \$6.2B 'Living with water' plan | NOLA Defender |
| Ambitious plan to change New Orleans' relationship with water unveiled | The Times Picayune |
| Stormwater plan to use water, not eliminate it | The Advocate |
| GNO, Inc. Water Plan envisions canals and detention ponds | WWNO |
| Backers sell \$6.2B water plan as investment | New Orleans CityBusiness |

6.1.2 Policy

Policy and legislation are similar in nature but are often mixed up with one another. In this thesis policy is a document that outlines what a government, either local or federal, is going to do and what it wants to achieve. It is a set of decisions which usually have a long-term purpose. Policies are not binding. Legislation is laws that are binding and have to be done by government, private and public entities, and citizens.

6.1.2.1 Results

The following constraints in policies were identified in the interviews:

Different policies of entities or parishes

There are a lot of agencies working on storm water management on all different levels. Each of these agencies has their own missions and policies. These could conflict with each other and with the Urban Water Plan.

Lack in policy

Some cities in the United States have policies that incentivize green infrastructure. An example of such a policy could be that all new development should maintain their drainage on the property. In all three parishes in the project area there are no such policies. If redevelopment is done, the way the property is being drained, should be kept the same, so if for example a Walmart with a huge

non-permeable parking lot would change into a Home Depot, no changes have to be made to storm drainage, even though these large parking lots are a big strain on the current drainage system.

Commitment to policy

Policy will only work if you are able to commit to it and enforce it. This could mean that more staff needs to be hired to ensure this.

6.1.2.2 Discussion

Policies in the United States are usually stated in the form of comprehensive plans. Each of the parishes has a comprehensive plan.

Jefferson parish has two plans for the future, one is the comprehensive plan of Jefferson parish called "Envision Jefferson 2020" and the other is EDGE 2035, a plan of JEDCO (Jefferson Parish Economic Development Commission), which is an independent part of the Jefferson Parish government and seeks to attract, grow and create new business in the area. Like the GNO Inc. it has decided to make a plan to increase quality of life since this is believed to be a critical and driving factor in the future prosperity of the parish (JEDCO, 2013). The comprehensive plan of Jefferson Parish is now currently being revised, but in its draft version of the goals and visions does not include anything about drainage or floods (Jefferson County Departments of Planning and Zoning, 2013). The plan of JEDCO does have actions when it comes to drainage and managing floods. It makes a clear difference in external flood protection, the levee system, and internal flood protection, the drainage system. Yet the plan only looks at improving the current drainage system and its pumps and hardly includes any type of strategies that the UWP proposes (JEDCO and GCR & Associates, Inc., 2013).

Orleans Parish policy is formulated in the 'Plan for the 21st Century' and is also referred to as the Master Plan. The plan should be completed in 2030 and includes features that match with the UWP. By 2030 Orleans Parish wants to become one of America's greenest cities, which includes being resource-efficient, environmentally healthy and resilient. It also states it wants to become a global center knowledge on how to manage natural and man-made systems to prevent flooding in low-lying cities, which include having landscaped canals, parks with water features and shady, tree-lined streets that help reduce subsidence and managing water from storms (Goody Clancy, 2010).

St. Bernard Parish is also in the process of revising its comprehensive plan. The draft version now includes policy on stormwater management like encouraging the use of Best Management Practices (BMPs or stormwater control measures) for stormwater management. These BMPs, of which more information can be found in the Appendix E, include strategies and actions that are also part of the UWP. The draft of the comprehensive plan also includes improvements of the canal system by raising the water level in the canals to recharge groundwater and prevent subsidence as well as make them more attractive for public greenways, waterside plazas and trails. The draft of the comprehensive plan also refers to a study done in 2010 by Waggonner & Ball Architects, the authors of the UWP (Community Development Department, 2013).

It can be concluded that Orleans Parish and St. Bernard Parish have or are going to have more progressive policies towards urban water management and subsidence than Jefferson Parish. But even though these policies are somewhat different over the three parishes there is no reason to assume that these differences would be a constraint, since neither of these comprehensive plans is

opposed of measures in the UWP. The comprehensive plans of Jefferson Parish don't mention urban water management in this manner and doesn't even have subsidence as an issue. The comprehensive plans of Orleans and St. Bernard Parish actually support the UWP. Therefore it can also be concluded that only for Jefferson Parish there is a lack of policy.

When it comes to federal policy or vision on water management and flood control in the United States, there is none. Almost all of the policies in the United States on water focus on navigation and water quality, and not on flood protection and water quantity (Galloway, 2006). On a state level there is a comprehensive plan called the "2012 Coastal Master Plan". Even though it does not focus or have any plans towards urban water management, it does state that levees and restored wetlands cannot eliminate all damage from flooding and storms, so it recommends increasing awareness and the use of non-structural protection measures and it also recommends groundwater management (Coastal Protection and Restoration Authority, 2012). Other than the Coastal Master Plan there are no other policies that incentivize the Urban Water Plan. It can be said that there is a lack in policy on a state and especially a federal level.

Since most of these current policies are quite new, no conclusions can be made as to the commitment to policies. It will be a very important factor for the UWP to succeed. Commitment to policy can also mean making legislation to incentivize actions and projects in these comprehensive plans and the Urban Water Plan and to ensure when public and private entities, and citizens redevelop or develop new areas these policies are taken into account.

6.1.3 Legislation

Legislation can be on a federal, state or municipality level. Federal legislation is laws and regulations, state legislation is called legislature and on a municipality level legislation is done in the form of ordinances and codes.

6.1.3.1 Results

The interviewees had different opinions on whether or not legislation was going to be a constraint. On the one hand it was said that legislation can easily be changed if you have the right motive to back it up and that the ones that make legislation can also undo legislation. There was also no legislation that could prevent the UWP from being implemented. Yet other interviewees mentioned that there is one constraint that should be taken into account.

Lack in legislation/Old legislation

As well as a lack in policy there is a lack in legislation. There is no existing legislation that pressures local government to think about spending money to advance storm water management in a more natural way. On the other hand there is legislation that incentivizes more impervious areas, for example in Jefferson parish there is an ordinance about the minimum amount of parking spaces that is needed for new development, and doesn't include parking spaces that have already been build in the area surrounding it. The legislation that does exist is often tied to the size of the development, so houses and small apartment buildings are usually not included.

6.1.3.2 Discussion

There is legislation on a federal, state and parish level. The only federal legislation towards storm water is the Clean Water Act¹⁴, which focuses on the pollutants in discharge to water bodies. Yet, it doesn't look at the amount of discharge. The Clean Water Act also includes the MS4 permit¹⁵ to which all three parishes are committed. The MS4 permit does force the parishes to think about green infrastructure and more innovative ways to manage storm water, but only for the purpose of the quality of water. The EPA is currently also busy with more progressive legislation, but this still needs to pass through Congress. This new rulemaking is to reduce stormwater discharges on newly and redeveloped sites. However this rulemaking, just like the other federal rulemaking, focuses more on water quality than on water quantity and stormwater protection. Also this rulemaking has not yet been approved by congress. But if the stormwater rule of EPA¹⁶ passes there will be more urgency and incentive to find funding for plans and ideas like the UWP.

The state doesn't have any legislation with regards to stormwater management and flood control but it does define the responsibilities of the state defined entities like the Sewerage and Water Board (SWB) and the levee boards.

On a parish level there are codes and ordinances on for example zoning and planning. Orleans Parish is currently working on the Comprehensive Zoning Ordinance (CZO)¹⁷ that is up for approval. The CZO is law that oversees land use throughout Orleans Parish, both public and private owned. The draft of the new CZO for the first time also includes stormwater management requirements about retaining stormwater on sight. Jefferson Parish is doing a study towards minimizing the number of parking spaces and adding more green spaces and changing building codes towards that. Local parking ordinances often govern the size, number, and surface material of parking spaces, as well as the overall geometry of the parking lot as a whole. The parking demand requirements are tied to particular land uses and zoning categories, and can create needless impervious cover. Most local parking codes are overly generous in the amount of parking lots that are needed and have few, if any, requirements to treat stormwater at source. More progressive rulemaking is not in the planning. St. Bernard Parish has no codes or ordinances on stormwater management on public or private properties. It can be concluded that both Jefferson and St. Bernard Parish don't have legislation to incentivize the Urban Water Plan. Orleans Parish has to wait and see if the new CZO gets approved or not. The passing of the CZO might even determine whether people are willing to think differently about the way stormwater has been managed. On all levels there tends to be a lack in legislation to mandate or even incentivize developments like the UWP.

6.1.4 Implementation

6.1.4.1 Results

For the actual implementation of the Urban Water Plan there are also some constraints and concerns that need to be overcome.

Less talk, more action

A lot of plans and ideas are killed by too much talk and not so much action. The cause for this is usually huge amount of meetings before something actually gets proposed and the will to make

¹⁴ More information on the Clean Water Act can be found in Appendix E.

¹⁵ More information on the MS4 permit can be found in Appendix E.

¹⁶ More information on the Stormwater Rule of the EPA can be found in Appendix E.

¹⁷ More information on the CZO can be found in Appendix E.

sure that everybody is on board and letting everybody, including the general public, have a say in the design. Also people are too afraid to make mistakes and are afraid of failure. One of the most heard concerns was that something that has been implemented somewhere else in the world, might not work for New Orleans. As one interviewee said: "These kind of concerns can kill a project without even trying. "

Problems with project areas

A lot of the projects in the UWP are planned in areas that are already very developed. Also people have been building up all the way to the banks of some of the canals, which could become a problem with the projects that propose to open up some of these canals. Real estate acquisition can be a huge challenge.

There are also a lot of utilities under the ground which can conflict with the projects, for example, underneath the medians there are drainage pipes and electricity lines which doesn't allow for very big trees to be planted. On the other hand it also has been mentioned to be a perfect area for these types of projects.

Health and safety concerns

A lot of people have concerns about mosquitoes, since New Orleans is notorious for vector borne diseases like West Nile. Therefore the general public may not be that supportive of retention areas. People are already very active when it comes to that by calling to the parishes when they see a couple inches of water in a catch basin or puddles in the gutter a day after a rainstorm.

For retention areas there is a rule that it should be drained within 48 hours, to prevent mosquito breeding. There are concerns that this rule might not be applicable for New Orleans, due to different environmental conditions and that it would be very difficult to predict whether a retention area will behave accordingly, since rainfall in New Orleans is very irregular in terms of frequencies and amounts.

In New Orleans vegetation grows very fast due to the climate. There are concerns that the rain gardens and bioswales that are proposed in the UWP will overgrow and become mosquito breeding sites.

Other concerns are the access to water for children and the quality of the stormwater in all waters that are introduced to the city.

6.1.4.2 Discussion

The first constraint shows the contradictions of the demonstration projects. The need for the demonstration projects to show the elected officials, the stakeholders and the general public that is going to work, or the learning component of what adjustments need to be made in order for these strategies to work in New Orleans, and on the other hand the ongoing discussion about that it is not proven to have worked for New Orleans and being afraid that these demonstration projects will be a failure. Some interviewees expressed the need of first doing its own pilot projects to see how some of the strategies work. One of the possible explanations for this can be that the current demonstration projects in the Urban Water Plan are considered to be too big to become failures and require a lot of different entities to work together, which might make it more difficult for each entity to learn from the parts that they are specifically responsible for, as was expressed in the SWOT analysis, see Chapter 5.

The designs in the UWP have been based on the current situation of the project areas, taking all the developments into account. A lot of the strategies will require rebuilding, for example the streets, but there are no areas in the plan where houses and other buildings will be taken down. As for land ownership, only one demonstration project is on private land, namely the Mirabeau Water Garden, but for this demonstration project arrangements are already in place.

Utilities are mainly an issue between the different stakeholders who will be responsible for the implementation of the UWP, drainage pipes and waterlines. As this plan moves forward this will have to be taken into account. In some projects, like the Lakeview Floating Streets, see paragraph 7.1, utilities have been taken into account with the design of the project.

The concern about mosquitoes has already been discussed in the SWOT analysis, see Chapter 5. But the fact that it is brought up again as a constraint shows how concerned people are about the potential of breeding sites. The concerns are valid, but the Urban Water Plan also has the potential to decrease the breeding sites for mosquitoes.

Like the concern on mosquito breeding, the concern on access to water for children is a valid one, though it was only mentioned by one interviewee. The concern about the water quality of the water bodies however can be discussed. Most of the strategies of the UWP are also Best Management Practices (BPM's) of the EPA that can be implemented for the MS₄ permit. The goal of the MS₄ permit is to increase water quality, so arguably the quality of water would improve if all of the Urban Water Plan was implemented.

6.1.5 Maintenance and Control

6.1.5.1 Results

For the Urban Water Plan to be a success maintenance has to be taken care of. Some interviewees believe that this will not be a big constraint as one interviewee stated: "I don't see any constraints. We build them, we maintain them. It would be maintained strictly by parish resources and staff." Also some interviewees think it might even be less maintenance than the current infrastructure and mentioning that maintenance was one of the things that was really thought about in the Urban Water Plan. It is not that easy according to all interviewees as the following constraints were mentioned.

Responsibility of maintenance and control

Who is going to be responsible for maintenance of these project areas? In all parishes these decisions need to be made. Is it the individual property owner, the nearest commercial property owner, a neighborhood association, the parish government and then, which department of the parish government or another entity?

Lack of maintenance

Maintenance is something that gets overlooked at for the long term, out of sight, out of mind. In Orleans parish they had a bad experience with a rain garden on OC Hailey which eventually was taken out, because the general public complained about it. The reason that it didn't work was that it wasn't maintained.

More maintenance needed

With the current infrastructure not a lot of maintenance is needed or is done. There are concerns that the amount of maintenance that is needed in order for these strategies to work is much higher than it is now.

Practical issues

Maintenance of green infrastructure is different from maintenance of the current infrastructure. One of the problems that were raised on canal improvements was how to get an excavator in it. If these green areas are not maintained properly they could potentially become mosquito breeding sites.

6.1.5.2 Discussion

The responsibility of maintenance and control is a constraint that needs to be solved before implementation of the UWP. Though maintenance costs can potentially be lower compared to the maintenance cost of conventional methods (EPA Office of Wetlands, Oceans and Watersheds, 2010), sufficient maintenance is needed in order for it to work properly and to prevent it from becoming a mosquito breeding site. With the current drainage system in Orleans parish there are already problems with the maintenance responsibilities. The Sewerage and Water Boards are responsible for the major drainage system and the Department of Public Works for the minor drainage system. A problem that they are encountering is that the Department of Public Works does not have the money to properly maintain the minor drainage system, which puts a strain on the major drainage system. Also the general public doesn't realize that there is a difference in that and when there is a problem with the drainage system always goes to the Sewerage and Water Board who then need to fix the problem. In Orleans parish the Department of Parks and Parkways is currently responsible for the maintenance of public green spaces. With the implementation of the Urban Water Plan, the amount of public green spaces would increase substantially, meaning a potential of having too much work for the department, as also was expressed in the SWOT analysis, see chapter 5.

Subsidence is responsible for a lot of the maintenance costs of Orleans Parish' Department of Public Works. Reduction of subsidence would save a lot of costs and work effort that can now be put into the maintenance of the projects of the Urban Water Plan. This does require a different approach in maintenance and some practical issues may arise, but, as one of the interviewees expressed, a lot of work has been put into making maintenance as easy as possible in the designs of the Urban Water Plan. Also maintenance efforts can be saved by reusing vacant properties across the project area as water retention areas. These areas are now being maintained for no specific purpose.

6.1.6 Organization

6.1.6.1 Results

As some seen in the organizational chart in Figure 10 on page 34 the project area has a rather complex organizational structure, which is bound to cause some constraints for implementation. Even though some interviewees said that there is some history of the entities working together, there were quite some constraints identified.

Responsibility of the different aspects of the Urban Water Plan

Every entity has its own jurisdiction, from the Department of Public Works, to the Port of New Orleans, to the levee boards, to the Sewerage and Water Board. What is going to be the role of each of these entities and what should their jurisdiction be in order to make the Urban Water Plan

implementable. Currently, there is no entity responsible for groundwater monitoring and stabilization.

Structural changes within the city due to change of mayor

As was already discussed in paragraph 6.1.1: Politics, the mayor in Orleans parish serves a four year term and is allowed to sit for 2 terms. Currently all the infrastructure including the drainage system is consolidated under one deputy mayor. The way it is organized right now would support implementation of a plan like the UWP. However, if a mayor changes, the whole organizational structure can change and even the directors of the different departments can be replaced. This makes it more difficult to look at long term planning and it might cause a whole philosophy change within the parish government.

Fragmentation (local/regional)

In Louisiana there used to be a more centralized planning effort when the state still had the division of administration. They did a lot of coordination on a regional level, but since politics on a state level have changed and become more fragmented, these efforts have become more of a local responsibility.

Even though there is now a somewhat regional levee board that covers the whole project area, these are still fragmented smaller divisions, due to the fact that money can't cross jurisdictional borders as mentioned previously.

The fragmentation is not only on a regional level, but also on a local level, within the parishes. This is clearly seen that in some parts of Orleans parish where you have wheelchair accessible ramps, which is the responsibility of the Department of ADA (Americans with Disabilities Act), but there is no sidewalk on either side of it, which is the responsibility of the Department of Public Works. The same goes for the SELA project in Orleans parish, the SWB and the DPW are both at the table for those projects, but DPW doesn't necessarily get the improvements for their part of the system, the minor drainage system.

Regional plan, local responsibilities

The plan is a regional plan, but all the responsibilities on storm water management are local. Even though water is not confined to jurisdictional borders, in the Greater New Orleans Area it seems like it is. In some cases physical constraints have been build on parish lines so that water can't travel over jurisdictional borders.

Coordination

In the bureaucracy different department don't typically coordinate around one common goal. Since there are significant differences between the parishes, coordination is very important. The big question is, how is this all going to be coordinated so that everything is moving in the same direction and who is going to coordinate all of this. Who is going to get all the different entities to one table and starts making real planning efforts to do some of these projects in a way that the whole region benefits.

Not only coordination between parishes but also coordination between entities in one parish should be better. There is for example no coordination about fixing the streets and fixing the utilities under the streets. Therefore it is not that strange that the DPW will come in and do some street repairs, while a few weeks later the SWB might come in to make repairs on the waterlines, tears up the

street again and repairs it again, and another week later some other entity that needs to be underneath the street tears up again.

Cooperation and agreement between entities and parishes

Cross-jurisdictional cooperation has been very difficult and there are not a lot of examples of successful cooperation and more examples of unsuccessful cross-jurisdictional cooperation. A lot has to do with perception, for example Jefferson parish does not want to be tied into anything that goes on in Orleans parish because there used to be a lot of corruption. To get around that mindset will take some time. Getting cooperation and agreement between the entities and parishes might require a change of culture within some of the entities.

6.1.6.2 Discussion

The Urban Water Plan contains a lot of aspects that require coordination between the parishes and the entities, or these aspects won't have the wanted effect on reduction of flooding. Especially these large scale strategies, for example circulating the canals or splitting the drainage at the risk, can't be done without overcoming these constraints. The plan needs to be a regional effort if it wants to succeed. In the current situation big regional plans are only implemented if the state or federal government comes in and mandates it, one of the interviewees expressed.

As can be seen in the chapter 4 the stakeholder analysis the responsibilities with regards to urban drainage are different for each parish. The Urban Water Plan can be divided into four key components: the major system, the minor system, groundwater and green infrastructure. In New Orleans the first is the responsibility of the SWB, the second of the DPW and the third and fourth are don't fall under any entities jurisdiction, but there are departments that work with green infrastructure, for example the SWB has a Department Environmental Affairs who are currently working with green infrastructure. In Jefferson parish the Drainage Department is responsible for the first and second component and there is no one responsible of the third and fourth component. The same goes for St. Bernard, where the first two components are the responsibility of the Lake Borgne Levee District and the last two components don't fall in anybody's jurisdiction.

Another problem that comes with groundwater monitoring and stabilization is that there is a lot of liability involved, because if somebody's slab cracks, or if somebody's wall cracks, the general public is going to go to that entity and could state that the groundwater level wasn't maintained at a proper level. Therefore most entities and several of the interviewees are very cautious about taking responsibility for that.

6.2 Funding and Paradigm Shift

In this paragraph constraints are described which belong to more than one part of the chain model. Funding is a constraint that can be placed in implementation and maintenance and control, and paradigm shift can be placed in politics and organizations. These constraints are the two most mentioned constraints by the interviewees, see Table 5.

Funding

Almost all the interviewees said that funding is going to be a major constraint or at least it will be a challenge to figure out who is going to pay for what and some even mentioned it being the only real constraint for implementation of the Urban Water Plan. Most of the stakeholders are saying that there should be a dedicated ongoing source of funding for the Urban Water Plan, for both implementation and maintenance and control. Especially for maintenance there has to be a long term financing plan that does not come out of grants which are only provided once. Such a dedicated ongoing source of funding would need to come from millage money or taxes and fees. To get these sources of funding the general public must agree with a raise and therefore needs to buy-in with the Urban Water Plan. The last time the SWB tried to increase the millage the general public opposed of it. But currently they are trying to develop and implement a drainage service charge that is going to be based on a combination of impervious surfaces and total surface area. The fee should create funding to construct assets and is accompanied by policies that provide offsetting credits for when people do investment in green infrastructure.

An extra challenge will be for the projects that cross jurisdictional borders. As mentioned before the South East Flood Protection Authority East is encountering this problem after they were merged from being three separate levee boards. As things are going now, basically Orleans is going to pay for Orleans projects, Jefferson for Jefferson projects and St. Bernard for St. Bernard projects. With that not every parish can come up with the money as easily as the other. Jefferson parish probably has the most resources to do projects of the Urban Water Plan and would be able to implement it quicker than Orleans and St. Bernard parish. St. Bernard parish is struggling to have a sufficient tax base with only 50% of the total population returning after Katrina. The question that remains is if the Urban Water Plan can be implemented properly with these jurisdictional funding challenges.

Some of the departments like the Department of Parks and Parkways have received major cuts in their budget and are not able to be pro-active anymore. The only way for these kinds of departments to be able to participate is if somebody else comes up with the funding and involves them. The Department of Public Works is also not able to fund the current maintenance on the minor drainage system, since they are underfunded as well. This already brings gaps in funding without even implementing the Urban Water Plan. In St. Bernard Parish the Water and Sewer Department is barely holding up and is able to hold its own weight for about 99.9%. They occasionally need to borrow money from other departments. Therefore they are very reluctant in building projects that don't generate any money back. A problem is that the whole of New Orleans is build for a population of 600 thousand, but currently there are only 400 thousand people. This comes down to having a bigger infrastructure network than that there is being paid for. Most of this can be seen in the lack of maintenance on a lot of infrastructure.

Funding also comes down to prioritizing the money that the different departments have. Therefore if you give an infrastructure intensive organization more money, they will probably invest it in more

grey infrastructure, instead of investing it in green infrastructure. It might be useful to create some sort of legislation around extra funding, which could for example state that 20% of the whole budget should be invested in green infrastructure.

Paradigm Shift

A lot of the constraints come down to a change in mindset, a paradigm shift. Not only for the general public and the public officials but also the organization need to change their mindset on how to deal with storm water management before the Urban Water Plan can be implemented. Such a paradigm shift is probably more of a generational assignment and won't happen in a couple of years.

The public needs to change their mindset, since they need to buy-in towards the Urban Water Plan in order for any raises in millage, fees or taxes can be possible. Also they need to be okay with the fact that water around is not a bad thing and it doesn't always create a mosquito breeding site. For example in Jefferson parish the streets are used for retention, but only a small portion of the general public knows that is the reason why streets flood and start calling the parish government with complaints. People need to be prepared for the transition of how water was managed and how it will be managed and that it will take time before everything is implemented. According to some of the interviewees there has always been a resistance to change in New Orleans; people don't want to see water near them, other than the Bayou St. John or City Park. Also people need to get accustomed to a different type of aesthetic. For example there a lot of neighborhoods in Orleans Parish which don't want trees to be planted in their neighborhoods. Even after proposals from the city the public in these neighborhoods don't want to see in trees in their neighborhood.

Most of the organizations in this region have existed for a long time and have a history of more than 100 years of managing water the same way, with pipes and pumps and concrete structures. There is a newer generation coming in and shaking things up, but the older generation might be in a certain mindset and want to do things in a certain way. This older generation needs to be taught that there is a different way to do stormwater management and they have to want to use this more natural solution. It is not typically what engineers are trained to do; they are trained to make manufactured and designed solutions, rather than natural solutions. So the organization needs to see that this is what they want to do.

Also there is always some misunderstanding between an architect and an engineer, between the planner and the contractor, between the vision and the nuts and bolts. There are always feelings about not appreciating each other's work. This mindset also needs to change so these different parties can work together.

6.3 Conclusions

The constraints of politics will be most difficult to predict, since it is probably most difficult to influence the public and public officials compared to the constraints in other parts of the chain model. There are possibilities to influence the process of agenda-setting by creating policy-windows and using policy-windows when they appear.

The constraints in policy and legislation might be the easiest to overcome, since these constraints don't prevent the Urban Water Plan from being implemented if the constraints in politics are overcome. But improvements in policy and legislation that incentivize implementation of the Urban Water Plan or even mandate it, might overcome problems in the organizational structure.

Some of the identified constraints on implementation and maintenance can be accounted to not knowing enough about the Urban Water Plan, since some of these issues are taken into account, like the amount of development in the areas, implementing in private areas and the amount of maintenance.

Responsibilities of maintenance and groundwater monitoring and stabilization need to be defined, but needs to be accompanied by clear defined liabilities and additional funding and personal.

For the organizational constraints structural changes would be most ideal, for example giving the SWB in Orleans parish full responsibility over the major and minor drainage system. The organizational constraints will prevent the large scale strategies, like the circulating the canals, from being implemented; however small-scale retrofits will probably be less of a problem considering these constraints.

Funding and a paradigm shift are the most mentioned constraints and is necessary in several parts of the chain model. Parishes should prioritize funding towards the Urban Water Plan, which comes down to public officials buying into the plan. A lack of funding usually results in a lack of maintenance. A paradigm shift is needed on all levels, public officials, stakeholders and the general public. This comes down to education and showing how water can be managed differently.

MCDA

Several of the interviewees expressed that making a prioritization would be very helpful for the implementation of the UWP. This chapter shows how a prioritization can be made of the various elements, for example pervious pavement and bioretention & infiltration, which the UWP contains, by making a multi-criteria decision analysis (MCDA) with regards to the identified constraints in Chapter 6 and several criteria that are mentioned in the UWP. The outcome will show which elements and projects, which are combinations of these elements, are easier to implement and also most effective to implement, the so-called low-hanging fruit.

7.1 Method

The ELECTRE¹⁸ III method is used to do the MCDA. ELECTRE III is an outranking method which consists of 2 by 2 pair-wise comparison of alternatives based on the number of criteria on which one alternative outperforms or is indifferent to the another alternative. By taking an indifference threshold into account and multiplying this information with the weights of the criteria, a credibility or concordance matrix can be made which shows overall credibility that an alternative is at least as good as another alternative (Roy, 1991; Rogers & Bruen, 2000; Pruyt, 2009).

The ELECTRE method was chosen because it gives a ranking of alternatives, there is a possibility for alternatives to rank equally as high and it can make use of qualitative data.

¹⁸ ELECTRE stands for Elimination Et Choix Traduisant la REalité (Pruyt, 2009).

7.2 Input

This MCDA will be made with regards to the elements. It would probably be more effective to make an MCDA based on the different projects, however this proved to be quite difficult since there is no data available for the specific projects on how they reduce flood risk or limit subsidence. Also it was more difficult for the interviewees to give scores on the different projects, since that would require them to know what each of the various projects include, whereas the elements are much easier to explain. The UWP contains 12 water management elements¹⁹ in total. Since it will be too time-consuming to outrank all these elements in the interviews a selection of elements was made that are going to be outranked. Because the goal of this chapter is to demonstrate if an MCDA is an effective method to prioritize projects, this will be sufficient. The alternatives that are going to be outranked are: pervious pavement (PP), bioretention & infiltration (B&I), plants (P), subsurface storage (SS) and exfiltration (E). These elements will be outranked with regards to several criteria and the most mentioned constraints by the stakeholders, see Table 9. The weights are an average of what was determined by each of the stakeholders during the interviews and the follow-up. The performance of the elements with regards to the criteria is based on what is mentioned in the Urban Water Plan. The performance of the elements with regards to the constraints is what the stakeholders have mentioned in the follow-up. Both can be seen in Table 10 where 1 is the worst possible score and 5 the best, for example, if an element scores a 5 for funding it means that it is considered a cheaper element than an element that scores a 4 or lower.

Table 9: Weights of Criteria and Constraints

| | Criteria | | | | | | Constraints | | | | | |
|-------------|---------------------------------|--------------------|-------------------|---|------------------------------------|---------------------|---------------------------------|------------------------------------|------------------------|----------------------|------------------|---------|
| | Provides multi-level protection | Reduces flood risk | Limits subsidence | Attracts & retains businesses and investments | Increases citizens quality of life | Enriches ecosystems | Buy -in from the general public | Developed or private project areas | Unclear responsibility | Lack of coordination | Changing mindset | Funding |
| All | 19.1 | 23.0 | 19.1 | 10.9 | 17.0 | 10.9 | 12.2 | 11.7 | 9.4 | 9.4 | 15.6 | 41.7 |
| Jefferson | 50.0 | 15.0 | 10.0 | 10.0 | 10.0 | 5.0 | 10.0 | 7.5 | 12.5 | 12.5 | 25.0 | 33.0 |
| Orleans | 16.7 | 26.7 | 23.0 | 8.3 | 16.7 | 8.3 | 11.0 | 8.8 | 10.0 | 10.0 | 8.8 | 51.0 |
| St. Bernard | 16.7 | 15.0 | 18.0 | 13.3 | 23.3 | 13.3 | 20.0 | 15.0 | 7.5 | 7.5 | 23.0 | 28.0 |

¹⁹ The Urban Water Plan makes use of 12 water management elements or strategies in total: green roofs, plants, bioretention & infiltration, exfiltration, pervious paving, water harvesting, subsurface storage, improved canal, storage basin, constructed wetland, circulating network and redirected discharge. More information on these strategies can be found in Appendix B or www.livingwithwater.com.

Table 10: Performance of the elements on constraints and criteria

| Criteria | Provides multi-level protection | Reduces flood risk | Limits subsidence | Attracts & retains businesses and investments | Increases citizens quality of life | Enriches ecosystems |
|----------|---------------------------------|--------------------|-------------------|---|------------------------------------|---------------------|
| PP | 3 | 5 | 5 | 1 | 3 | 3 |
| B&I | 5 | 5 | 5 | 1 | 4 | 5 |
| P | 3 | 5 | 3 | 3 | 3 | 5 |
| SS | 3 | 5 | 5 | 3 | 5 | 3 |
| E | 5 | 5 | 5 | 1 | 3 | 3 |

| Constraints | Buy-in from the general public | Developed or private project areas | Unclear responsibility | Lack of coordination | Changing mindset | Funding |
|-------------|--------------------------------|------------------------------------|------------------------|----------------------|------------------|---------|
| PP | 4.4 | 3.3 | 4.0 | 4.2 | 3.5 | 1.7 |
| B&I | 3.0 | 3.1 | 3.1 | 3.5 | 3.2 | 2.2 |
| P | 4.0 | 3.6 | 3.2 | 4.1 | 3.9 | 3.0 |
| SS | 3.6 | 2.8 | 3.5 | 3.3 | 2.9 | 1.6 |
| E | 3.2 | 3.0 | 3.3 | 3.5 | 3.0 | 1.9 |

The indifference threshold is set at a difference of half a grade. Choosing an indifference threshold that is too high will result in no clear outranking. By choosing no indifference threshold, small differences in performances can make quite a big difference in outranking. Rogers & Bruen (2000) used one grade as an indifference threshold, but used twice as many grades, therefore half a grade is chosen. Within ELECTRE III there is also a possibility to choose a veto threshold, where an alternative will rank lowest when this threshold occurs in a pair wise comparison. For this analysis there is no need for a veto threshold, since none of these criteria or constraints give reason to provide one. A veto threshold is usually applied with criteria that can have a severe negative impact and are bound to legislation, for example water quality (Rogers & Bruen, 2000).

7.4 Results

A credibility matrix, as seen in Table 11 can be made by adding the weights for which an element outperforms another element by more than the indifference threshold.

Table 11: Credibility Matrix

| | PP | B&I | P | SS | E |
|-----|-------|-------|-------|-------|-------|
| PP | - | 0.557 | 0.683 | 0.861 | 0.904 |
| B&I | 0.844 | - | 0.493 | 0.8 | 1 |
| P | 0.857 | 0.724 | - | 0.82 | 0.809 |
| SS | 0.708 | 0.642 | 0.554 | - | 0.904 |
| E | 0.767 | 0.861 | 0.438 | 0.861 | - |

The algorithm for ranking all the elements is done in two pre-orders, each constructed in a different way. The first pre-order is done in a descending manner by selecting the best-performing elements first and finishing with the worst-performing element. This is called the downward distillation. The second pre-order is called the upward distillation and selects the worst-performing element first and

finishes with the best-performing element. To make these pre-orders a cutoff level for outranking is required. This cutoff level of outranking λ_1 is defined as the largest outranking score, which is just less than the maximum outranking score minus the discrimination threshold:

$$\lambda_1 = \max_{S(a,b) < \lambda_0 - s(\lambda_0)} S(a,b)$$

Where $S(a,b)$ is a value in the credibility matrix and λ_0 is equal to the maximum value of $S(a,b)$ in the above table, which is 1. The discrimination threshold can be set as follows (Rogers & Bruen, 2000):

$$s(\lambda) = 0.2 - 0.1\lambda$$

In every situation where element a outranks element b, a is given the score +1 (strength) and b is given -1 (weakness). At the end of a step the individual strengths and weaknesses of an element are added together which gives a final qualification score. When performing the downward distillation, the element (or elements) with the highest score is (are) assigned to a rank and removed from the set. This process is continued until all elements are assigned a rank. The upward distillation follows the same procedure, only now the element with the lowest qualification score is assigned a rank and removed to the set.

Table 12 shows the downward distillation and the upward distillation. This results in the following outranking:

| Downward | Upward |
|----------|--------|
| B&I | PP |
| ↓ | ↓ |
| PP | B&I |
| ↓ | ↓ |
| SS | PP |
| ↓ | ↓ |
| P | SS |
| ↓ | ↓ |
| E | E |

The results of the two procedures need to be combined to give a final ranking which is consistent with both procedures. This results in the following outranking:

| | |
|-----|---|
| B&I | |
| ↓ | |
| PP | |
| ↓ | |
| SS | P |
| ↓ | ↓ |
| E | |

Based on the socio-institutional constraints and the performance of the strategies towards criteria like subsidence and flood-prevention, it can be concluded that bio-retention & infiltration and plants are the low-hang fruit in the floating streets.

Table 12: Upward and Downward Distillation Process

Upward Distillation

| Step 1 | | | | | |
|---------------|----|-----|---|----|----|
| $\lambda=0,9$ | | | | | |
| | PP | B&I | P | SS | E |
| S | E | E | | E | |
| Strength | | 1 | | 1 | |
| Weakness | | | | | 3 |
| Qualification | 0 | 1 | 0 | 1 | -3 |
| C1: B&I | | | | | |

| Step 2 | | | | | |
|---------------|----|--|---|----|----|
| $\lambda=0,9$ | | | | | |
| | PP | | P | SS | E |
| S | E | | | E | |
| Strength | | | | 1 | |
| Weakness | | | | | 2 |
| Qualification | 0 | | 0 | 1 | -2 |
| C2: PP | | | | | |

| Step 3 | | | | |
|---------------|--|---|----|----|
| $\lambda=0,9$ | | | | |
| | | P | SS | E |
| S | | | E | |
| Strength | | | 1 | |
| Weakness | | | | 1 |
| Qualification | | 0 | 1 | -1 |
| C3: SS | | | | |

| Step 4 | | | | |
|---------------|--|---|--|----|
| $\lambda=0,8$ | | | | |
| | | P | | E |
| S | | E | | |
| Strength | | 1 | | |
| Weakness | | | | 1 |
| Qualification | | 1 | | -1 |
| C4: P | | | | |
| C5: E | | | | |

Downward Distillation

| Step 1 | | | | | |
|---------------|----|-----|---|----|----|
| $\lambda=0,9$ | | | | | |
| | PP | B&I | P | SS | E |
| S | E | E | | E | |
| Strength | | 1 | | 1 | |
| Weakness | | | | | 3 |
| Qualification | 0 | 1 | 0 | 1 | -3 |
| C1: E | | | | | |

| Step 2 | | | | | |
|---------------|----|-----|-------|----|--|
| $\lambda=0,8$ | | | | | |
| | PP | B&I | P | SS | |
| S | SS | PP | PP,SS | | |
| Strength | 1 | 1 | 2 | | |
| Weakness | 2 | | | 2 | |
| Qualification | -1 | 1 | 2 | -2 | |
| C2: SS | | | | | |

| Step 3 | | | | |
|---------------|----|-----|----|--|
| $\lambda=0,8$ | | | | |
| | PP | B&I | P | |
| S | | PP | PP | |
| Strength | | 1 | 1 | |
| Weakness | 2 | | | |
| Qualification | -2 | 1 | 1 | |
| C3: PP | | | | |

| Step 4 | | | | |
|---------------|--|-----|-----|--|
| $\lambda=0,7$ | | | | |
| | | B&I | P | |
| S | | | B&I | |
| Strength | | | 1 | |
| Weakness | | 1 | | |
| Qualification | | -1 | 1 | |
| C4: B&I | | | | |
| C5: P | | | | |

As can be seen in the following ranking with the constraints and the criteria separately, plants is the most easiest to implement when it comes to overcoming the constraints and bio-retention and infiltration performs best with regards to the criteria and can be considered the most effective strategy:

| Criteria | Constraints |
|----------|-------------|
| B&I | P |
| ↓ | ↓ |
| SS | B&I |
| ↓ | ↓ |
| P,E | PP |
| ↓ | ↓ |
| PP | SS |
| | ↓ |
| | E |

An outranking has also been made for the different parishes²⁰. The results are as following:

| Jefferson | | | Orleans | | | St. Bernard | | |
|-----------|----------|-------------|----------|----------|-------------|-------------|----------|-------------|
| Combined | Criteria | Constraints | Combined | Criteria | Constraints | Combined | Criteria | Constraints |
| B&I | B&I | B&I,P | SS | B&I | SS | B&I,P | B&I,SS | P |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| P | SS | PP | PP | SS | PP | PP,SS | P,E | B&I,PP |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| PP | E | E | E | E | E | E | PP | SS,E |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | | | |
| E | P | SS | P | P | P | | | |
| | ↓ | | | ↓ | ↓ | | | |
| | PP | | | PP | B&I | | | |

Most salient of these rankings is that in Orleans parish bioretention & infiltration is least favorable for implementation when it comes to the constraints, while in most other rankings this element is ranked highest. This is due to the fact that it scores lowest on the constraints buy-in from the general public, unclear responsibility of the stakeholders, lack of coordination between the stakeholders and a change of mindset.

The rankings also show that pervious pavement scores much better with regards to the constraints then it does with regards to the criteria.

7.5 Sensitivity Analysis

A sensitivity analysis shows how the variation in output of the MCDA can be apportioned, to different sources of variation, and how the MCDA depends on input information. The sensitivity is similar to the one described by (Rogers & Bruen, 2000). This sensitivity analysis aims to investigate the influence of the indifference threshold and the ranking stability of the weights. All scenarios that were performed, are done with the constraints and criteria combined.

²⁰ Only the performances and weights of interviewees that have jurisdictions within a parish are taken into account. The interviewees that have jurisdictions that are larger than these parish boundaries are not considered in this ranking.

For the sensitivity analysis of the indifference threshold two scenarios were done, one with an indifference threshold of 1, and another with no indifference threshold. The results are as follows:

| Original Situation | Indifference Threshold of 1 | No Indifference Threshold |
|--------------------|-----------------------------|---------------------------|
| B&I | B&I | P |
| ↓ | ↓ | ↓ |
| PP | SS, P | B&I |
| ↓ | ↓ | ↓ |
| SS P | E | PP |
| ↓ ↓ | ↓ | ↓ |
| E | PP | SS |
| | | ↓ |
| | | E |

There are changes in the ranking of the elements due to changes in the indifference threshold, however, the same elements can be considered better in the original situation as in the new scenarios. Bioretention & infiltration and plants are ranked high and exfiltration is ranked low in all three scenarios.

For the sensitivity analysis of the weights two scenarios were done. The first scenario adds 10 points to the lowest three criteria and constraints and subtracts 10 points from the upper three criteria and constraints, bringing the criteria and constraints closer to each other, creating a moderate scenario. The second scenario subtracts 5 points of the lowest three criteria and constraints and adds 5 points to the upper three criteria and constraints, making it a more extreme scenario. The results are as follows:

| Original Situation | Moderate Scenario | Extreme Scenario |
|--------------------|-------------------|------------------|
| B&I | P | B&I |
| ↓ | ↓ | ↓ |
| PP | B&I | PP |
| ↓ | ↓ | ↓ |
| SS P | PP | E P |
| ↓ ↓ | ↓ | ↓ ↓ |
| E | SS | SS |
| | ↓ | |
| | E | |

The sensitivity analysis of the weights shows that the results can be considered robust. Bioretention & infiltration as well as plants score well in all three scenarios and exfiltration and subsurface storage are outranked in the last positions in all three scenarios.

7.6 Conclusions

The first conclusion that can be made is that there is a difference in what can be best to implement with regards to the criteria and the constraints. What is best for prevention of flooding and subsidence is not always the easiest to implement. Also it might be rewarding to take a different approach in each parish with regards to the elements that are implemented. The question remains

whether which elements should be preferred, the one that are easiest implemented or the one that are most effective. For making a prioritization, the ones that are easiest implemented, meaning the elements that rank highest for the constraints could be considered first.

Funding is considered the most important constraint and also has a much higher weight than the criteria. It was also the most mentioned constraint by the interviewees. All elements were given a lower performance score than most of the other constraints. Especially subsurface storage and pervious pavement are considered to be costly alternatives.

As mentioned before, it would probably be better to outrank the projects, instead of the elements, since the projects are combinations of these elements and a project will not have the effect as it was intended if only half of the elements that the project includes are used. However, in order to do this more data would be needed on how these projects perform with regards to the criteria and more time should be taken to make an MCDA with the stakeholders. On the other hand, if all the elements were outranked, projects with elements that are all ranked high are projects that can easily be implemented and are effective. For example in Jefferson Parish it would be better to implement projects that contain plants and bioretention & infiltration, rather than projects that involve pervious pavement and exfiltration. This could be a way to make a prioritization.

The interviewees did express that a prioritization for the plan should be made, which should be based on the effectiveness of each of the projects and the necessity of the projects with regards to the project area. When asked to prioritize the 8 project areas most of the interviewees found it difficult to do so, or even not a fair thing to do. The ones that were able to make a ranking of the areas based this on how much the area needed to be protected from flooding and when implemented would have the most effect on reducing the load on the drainage system.

ELECTRE III proves to be a nice tool to show what elements can be implemented easiest. By using this tool a prioritization of the whole Urban Water Plan can be made. All in all, a prioritization of the projects or the elements could be helpful in the long run to get more buy-in from the stakeholders and makes it easier to comprehend what is expected from them.

Next Steps

The Greater New Orleans Urban Water Plan brought a new vision for the future of New Orleans, now implementation is needed. There are various steps that can be taken. This chapter describes what possible next steps can be made towards implementation of the Urban Water Plan. The results of the previous chapter will be used. But before giving next steps, a discussion on the results of the previous chapters is given in the first paragraph. After that, solutions for improvement of the plan with regards to the SWOT analysis and the reference projects are given. Next, solutions and opportunities to overcome the constraints within the chain model are mentioned. Finally the next steps with regards to the outcomes of the MCDA are provided.

8.1 Discussion on Results

The results are based on the input of the stakeholders during the interviews and the follow-up. The interviews were conducted in a semi-structural manner. This was done so that aspects that deemed to be interesting could be more elaborated on during the interviews. This is a subjective choice, therefore, if someone else conducted the interviews, the results could have been different. Yet, the results do confirm what can be found in literature on implementation of green infrastructure and integrated water management practices, see chapter 6. Also, the interviewees didn't vary that much in output. Therefore it seems that the results on the constraints and the SWOT analysis from the interviews can be considered reliable.

The input of the stakeholder analysis by the interviewees on how they rated themselves as being powerful and interested can be questioned. To what degree are stakeholders able to rate how powerful they are? It might have been better if the stakeholders would rate each other. However, the first interviewees were hesitant in rating other stakeholders, therefore it was not done in following interviews. If this would have changed the results of the stakeholder analysis, this would probably not have a large effect on conclusions and recommendations. Since the outcome of the

stakeholder analysis only proved that the right stakeholders were interviewed, the ones with most interest, and more importantly, most power or influence. A change in the stakeholder analysis would only have resulted in doing more interviews, if this was even possible, considering the time that was available²¹.

The choice of interviews was based on a snowballing method, by first identifying the most mentioned stakeholders and asking these stakeholders to come up with more stakeholders. Based on the organizational chart in Figure 10, it can be seen that the interviewees are well spread across the chart. Due to the time that was available it was not possible to conduct more interviews. If there was, it can be questioned whether this would lead to different results. Since, as previously mentioned, the already conducted interviews had quite similar results and are similar to results found in literature. If there was opportunity to conduct more interviews, this would have been with stakeholders in a planning position, for example the City Planning Commission of Orleans Parish, the Planning Department of Jefferson Parish or the Department of Community Development in St. Bernard Parish, since these are a type of stakeholders that have not been interviewed, and could perhaps give more insight in the priorities of the parishes, with regards to development and drainage projects. For the same reason the redevelopment departments in Orleans or St. Bernard Parish would have been asked for interviews. The South-East Louisiana Flood Protection District East would have also been an interesting stakeholder to interview, since their jurisdiction is the exact same area as the project area of the Urban Water Plan. They could have given more insight in constraints they encounter when doing their job. However, this has also been covered in interviews with the other stakeholders who work closely with the South-East Louisiana Flood Protection District East. Therefore it might not contribute a lot to the already collected data from interviewed stakeholders.

The results of ELECTRE III, the MCDA, seem to be quite robust as can be seen in the sensitivity analysis. But the amount of elements that were outranked are limited, therefore the robustness of the results could be different if more elements were included. Also it can be questioned whether the performances of the constraints with regards to the elements which were provided by the stakeholders are correct. A sensitivity analysis for an MCDA is usually conducted on the weights, as is done in this thesis, but in this case the performances of the elements are also found subjectively instead of objectively, just like the weights. The goal was to see whether this method was good for prioritizing the elements and projects of the Urban Water Plan. If the outcomes would have been different, the recommendations on ELECTRE III would probably have been different.

8.2 Urban Water Plan Recommendations

Before asking the stakeholders to change their way of working, it is also possible to look at how to adjust the plan in order for the stakeholders to be able to implement the plan and sell it to the general public. The Urban Water Plan is a very big comprehensive plan. This is the strength of the plan, but it also is a weakness. It is quite difficult for a stakeholder to quickly see what is expected of him or her and how much this plan is going to affect his or her job. This can be solved by splitting the Urban Water Plan into components of which each stakeholder is responsible. This should be done on both a demonstration project scale as well as the whole Urban Water Plan in total. For each of these projects the stakeholders should be identified. In Figure 13 an example can be found of how it could

²¹ The interviews were conducting during a trip to New Orleans of 2.5 months.

be done for the demonstration project Lakeview Floating Streets in Orleans Parish. This can also be done on a much larger scale for the whole plan. Not only will this help the stakeholders see what is expected of them, but stakeholders might also see the plan more as something that should be implemented instead of just a vision. By performing such an analysis it might also be clearly seen which components of the Urban Water Plan don't fall under anybody's jurisdiction or which organizations could potentially be overwhelmed with the load of work.

One of the most mentioned weaknesses of the plans was the lack of technical details to back up the necessity of the Urban Water Plan. Some stakeholders were not sure about the fact that subsidence is a very serious issue, and if it is a serious issue, if these proposals in the Urban Water Plan would be the right solution for it. Especially for engineers the technical details are quite essential to buy-in to the plan and take the next steps toward implementation. Therefore the plan needs to contain more technical details and studies which show the necessity of the plan and that the proposed solutions will help.

As the MCDA showed, what is easiest implemented differs in each parish. Therefore an action plan can be made for each of the parishes. This action plan could contain a prioritization of the projects based either on what is easiest to implement based on the constraints or what is most effective based on the criteria that stakeholders in each of the parishes find most important. A prioritization of the projects and actions should be made and was also acknowledged by the stakeholders in the interviews as something that needs to be done.

8.3 Chain Model Recommendations

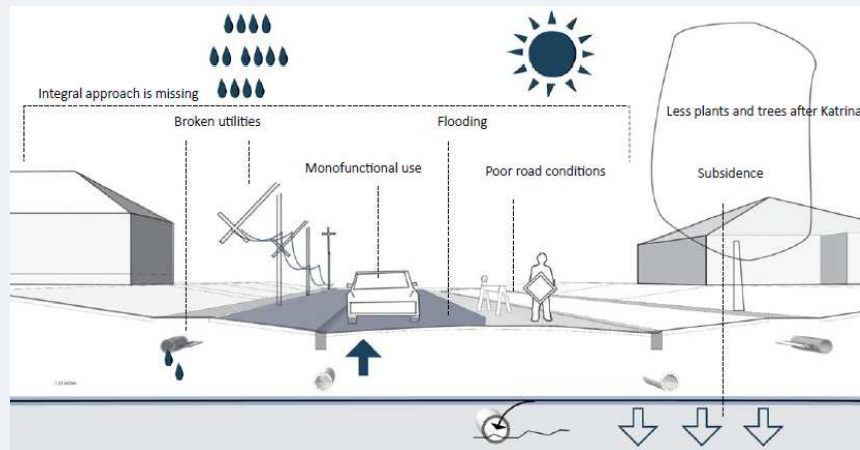
In the following paragraphs recommendations for next steps will be given for each part of the chain model. Since the ideal situation for the general approach might not be possible, adjustments in each part of the chain model can still help to realize projects and goals within the Urban Water Plan. Even though some of the steps that have been described are beyond what locally can be done, they are very good incentives for implementation of the Urban Water Plan, and therefore worth mentioning.

8.3.1 Politics

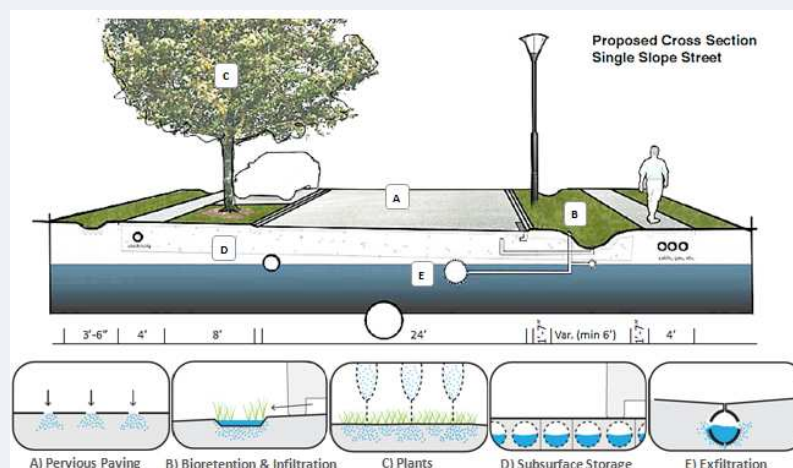
As mentioned in the chapter 6 the general public or neighborhood associations need to buy-in to the Urban Water Plan and ideally command from their elected officials to implement the plan. What also would be a great achievement is if the general public would buy-in with the plan and elect new public officials who are in favor of the plan or if the general public would not be willing to pay more drainage fees or millages without green infrastructure or if the general public would contact public officials and show that they believe it is necessary. However, in order for the general public or neighborhood associations to do any of this, they need to be more informed about the Urban Water Plan, about the opportunities and benefits that come with it, and especially on what is in it for them. If this message is clear this might ultimately make them care about what is done with flood control within the parishes and the choice between grey and green infrastructure. As can be seen in the survey in chapter 6 of all people that participated only one knew about the Urban Water Plan, and most of the people associated water management and urban drainage as not being dealt with properly in New Orleans. Also when explaining a couple of the different elements and the principals of the Urban Water Plan, hardly anybody was against it. This shows that there is a lot that can be gained by outreach to the general public. Buy-in of the general public can also be achieved by successful implementation of the demonstration projects.

Lakeview Floating Streets (Bosch Slabbers, Landscape + Urban Design, 2013)

The demonstration project Lakeview Floating Streets is situated in the north-west of Orleans parish. It consists of 5 street sections which make up 2 blocks in total. In the Lakeview area the street conditions are very poor. These conditions can be linked to several problems, including flooding, subsidence, broken utilities and lack of maintenance. As can be seen in the figure below an integral approach is missing. The floating streets concept is a way to solve the problem.



The floating streets concept consists of five different elements: Pervious Pavement, Bioretention & Infiltration, Plants, Subsurface Storage and Exfiltration. In the figure below a cross-section of a road can be seen with all the different elements. In a dry condition no water has to be transported towards the pumps and in case of a low groundwater table the permeable pipes can be used rise the groundwater table. During an average rain event, water will infiltrate into the ground, through the pervious pavement (A), the bioswales and the infiltration lines (B). The plants (C) will slow down the water. Water will then enter the subsurface storage (D) which will be used to temporarily store water. If all of this is used, water will be transported to the pumps. During a large rain event all components will be used as well as the full pump capacity of the already existing drainage system. As a last resort the streets can also be used for water storage.



This demonstration project can be split up into components that belong to an entity in the city. In this case the street with the pervious pavement and subsurface storage, the sidewalk and the connection of the bioswales with the exfiltration pipe would be the responsibility of the Department of Public Works. The bioswales, infiltration ditches and the plants would be the responsibility of the Department of Parks and Parkways. The exfiltration pipe (minimum diameter of 36 inches) would be the responsibility of the Sewerage and Water Board. Other stakeholders like the electricity company and other utility companies would also need to be included.

Figure 13: Lakeview Floating Streets, the proposal and the stakeholders

As explained in chapter 6, implementing policies and making sure that it gets on the agenda of local politics is done by making use of policy windows. These policy windows can be in the form of events. It is probably inevitable that the three parishes will experience severe flooding in the future by rainfall storms or rainfall that comes with a hurricane if this plan is not implemented. These type of events create good policy windows, but better use has to be made of them. After such an event most of the focus is into immediate recovery, but these events could and should be used to get policy change for better water management and green infrastructure as well as the necessity of implementing the Urban Water Plan. This can be achieved by already being prepared and organized, so when such a policy window appears, the public outreach is enough to get the buy-in needed for implementation. This can be done by so-called pro-change groups, at a grassroots level, but possibly also by other entities and organizations that are in favor of implementing the Urban Water Plan.

8.3.2 Policy

As mentioned in the chapter 6, policy comes down to the comprehensive plans of the parishes. Orleans Parish already has a master plan, "Plan for the 21st Century", that states the need of green infrastructure and includes a vision that is similar to the Urban Water Plan. St. Bernard Parish and Jefferson Parish are in the process of revising their comprehensive plans. The first draft of the comprehensive plan of St. Bernard Parish already includes the Urban Water Plan, in Jefferson Parish this is not the case. However, since both parishes are still in the process of revising, there are still opportunities to include more of the Urban Water Plan in these plans.

On a federal and state level there is a lack on policy on urban flood control and water quantity. Federal or state policy could be an incentive to implement the Urban Water Plan, especially on a more regional scale and not just on a parish scale. By having policies on a state or federal scale it would be easier to justify the larger scale strategies in the Urban Water Plan that go over parish boundaries. Therefore it would be a recommendation to develop policies on urban water management, flood control and water quantity on a higher level like federal or state.

8.3.3 Legislation

There is an overall lack in legislation. Legislation, just like policy, can be incentives for green infrastructure, especially when it comes to federal policy. An example is the MS4-permit of the Clean Water Act that now incentivizes local governments to think differently about water. Currently, no federal or state policies or legislation exist on water quantity or subsidence. The EPA is currently busy with a stormwater rule. It would be a great incentive if this stormwater rule passes through Congress.

On a parish level there are a couple of developments. Orleans Parish is currently revising the CZO, which now, in the draft version, includes an article on stormwater management. This is a big step forward if it will eventually be implemented as legislation. The other two parishes haven't included stormwater management in their ordinances, but it should be considered an opportunity to do so.

The next steps for legislation are partly awaiting the results for the stormwater rule on a federal level and the implementation of the new CZO in Orleans Parish. However in Jefferson and St. Bernard Parish there are opportunities to adjust legislation in favor of the Urban Water Plan when these are up for revision. Also smaller ordinances with regards to for example parking lots and roads as well as building regulations could be adjusted in favor of elements of the Urban Water Plan.

8.3.4 Implementation

An important next step is to communicate with the stakeholders. These first meetings should not only be informative to what the next actions should or can be, but should also have room for the stakeholders to express their issues with the Urban Water Plan. Most of the constraints that came up with the implementation are based on uncertainties. One of the constraints that has been mentioned are the project areas being too developed or are proposed in areas that are on private land. This is far from reality, since with the design of the Urban Water Plan this has been thoroughly taken into account. There are only projects on private land where the owner has already agreed with the idea and most of the projects and elements that are implemented are in areas where these developments are possible. Similar can be said for the health and safety concerns that have been mentioned. As previously mentioned, communication with the stakeholders is very important to take these uncertainties away. Also the threats and the weaknesses that were identified in the SWOT analysis should be addressed, since some of these threats and weaknesses were based on stakeholders not being informed well enough and some information that can't be found in the Urban Water Plan. This might implicate that experts should be included in these meetings, who can possibly take some of the concerns away. An example of such a concern is the mosquitoes. By involving an expert on this topic, the stakeholders might become convinced that the Urban Water Plan is actually a strength for this issue instead of a weakness or a threat, since according to the plan water will be circulated more and retention ditches will be emptied in 48 hours, as mentioned in paragraph 5.2.

Another reason to involve experts or more specific, engineers in the communication process is that engineers simply talk easier and are easier convinced by other engineers. This type of communication problem can be experienced in all types of processes, not just specifically in water management projects.

The constraints mentioned in this part of the chain model also show how important it is to implement the demonstration projects, so the stakeholders can learn from these projects and can also take away the concerns that they have with the Urban Water Plan.

8.3.5 Maintenance & Control

Even though this part of the chain model is more in the future and will be crucial after most of the other constraints are overcome, it is a very important factor to take in consideration. Especially, if this maintenance and control is taken care of properly the possible issues that the stakeholders have identified in the implementation component of the chain model could become reality. In the past there have been some bad experiences with the maintenance of a rain garden for some departments. Therefore it is crucial to have some successful demonstration projects on this part. Monitoring and evaluating each of these demonstration projects will be very important for education. The demonstration projects are also a good way to look at how to organize the responsibility of the maintenance and what potentially is the best way to do this. Where in the Netherlands most of the maintenance is done by government, in the project area there is also a tendency to do the implementation by government and pass the maintenance responsibilities on to neighborhood associations. These are quite different approaches, which each have their pros and cons. It is even possible that each parish has a different way which works best. The demonstration projects could be the ideal platform to test this.

8.3.6 Organization

The ideal situation for implementation of the Urban Water Plan would be a top-down approach where a regional entity is able to implement all of the projects. However this is far from the current situation. Currently there is no regional entity that has authority to do so and state and federal government seem to far on top to be leading the bandwagon. Suggestions have been made to make a regional entity which would be responsible for urban drainage of the whole basin. Similar has been done with the three levee boards in the project area which, after Katrina were combined into one bigger levee board. This has been an improvement, but the new levee board still lacks authority to implement cross-jurisdictional projects, since taxpayers money is not allowed to cross jurisdictional borders. Also a new regional entity means that either another entity is added to the already quite full arena or stakeholders should be willing to give up some of the responsibilities. In order for this to happen this would also require the state legislature to weigh in as it has been done with the South-East Louisiana Levee District. Since all this must first be put in place organizational change seems to be an unlikely option.

What could be a solution is a board or commission in which stakeholders from different entities and parishes participate which main task is to keep track of what steps have been taken for the implementation of the Urban Water Plan, and, more importantly, what steps each of the stakeholders should take for implementation. A regional entity, like for example the Regional Planning Committee or GNO, Inc. can lead such a commission or board. Similar has been done in for the implementation of the Green Infrastructure Plan of New York City, as mentioned in chapter 3, where a task force was set up to make sure that every new development or plan where possible implemented components of the plan. By creating a board of stakeholders from the different entities, each entity automatically has someone that is responsible for the implementation of the Urban Water Plan and someone that makes sure that all the parts of their entity come together. The board as a whole would then be responsible for all of the Urban Water Plan to be implemented and making sure that each of the different parts comes together.

8.4 General Approach Recommendations

The most general approach for implementation of green infrastructure is a top-down approach. Another option would be to not go for a top-down approach but for a bottom-up approach. Since there is no federal or state policy or legislation in place it makes it more difficult to implement a regional plan like the Urban Water Plan, because there is no legal incentive to work together. Even though it would have great benefits for the region towards flood protection, there is no culture of working together that would suggest it to be a big enough incentive. Without federal or state policy or legislation the question remains whether the approach that has been done until now, a top-down approach where the politicians need to be convinced of the necessity of the plan and give orders towards all implementing parties, is the most effective way to go. Since the neighborhoods in the region, especially in Orleans Parish, are considered strong entities, this could be a successful point to start implementation. Starting at a grassroots, neighborhood level, by implementing small-scale projects, which can then capture the attention of other neighborhoods. Ideally it would also capture the attention of elected officials, who can then start to implement these type of projects throughout their jurisdiction. This approach is good for the implementation of small-scale retrofits which are well represented in the Urban Water Plan, but for the large-scale adjustments, such as circulating the canals and splitting the drainage system at the ridge, this approach wont sufficient. This was

also mentioned in chapter 3 where grassroots was a good way to start of a project, but due to the lack of funding commitment and availability of workforce which can be found in local, it should eventually become the responsibility of local government.

8.5 Funding Recommendations

Funding has been appointed the biggest constraint for implementation, but it is also the number one constraint with the most opportunities to overcome. The Urban Water Plan already contains a lot of funding mechanisms and sources that can be used and can be applied for every year, and therefore it will not be elaborated on in detail here. Funding sources can be found in all different types of grants on state and federal level for the different types of elements that the plan contains. Also for this reason it can be very worthwhile to split the plan up in components, since there is no such grant that will fund the Urban Water Plan in total. Other opportunities can be found in projects that are currently being built. An example is the SELA (Southeast Louisiana) Drainage Projects, which are currently being build and for some part are still in the design phase. Combining these plans with some of the elements of the Urban Water Plan can be an opportunity. Another opportunity can be found at the Regional Planning Committee, who receives millions of dollars each year to do road projects. These road projects contain the opportunity to include bioswales and infiltration ditches, as well as pervious pavement. The part that will be most difficult when it comes to funding is to find a secure long term funding for maintenance, since this would probably require a raise in taxes or millages. The last time the Sewerage and Water Board requested a raise, this was denied, since people believed that they couldn't afford it, and there is also the distrust in the entities in if it will be properly spend.

Conclusions

Implementation of the Urban Water Plan will be a big challenge. There are a lot of questions that still need to be asked and answered to continue with implementation of the plan. For the stakeholders it is mainly questions about responsibilities and questions about funding. Who is responsible for the different components of the Urban Water Plan like monitoring of subsidence and long term maintenance? Are stakeholders willing to give up responsibilities in order to create a regional entity that will be responsible for urban drainage in the whole project area, or gain more responsibilities, which can be in the form of the previously mentioned subsidence monitoring but also the addition of a lot of green space will mean that some governmental entities will get an increased workload. Who is going to pay for the Urban Water Plan, preferably it would be in the form of a dedicated funding source from local government, such as a drainage fee or millages, but are the stakeholders willing to dedicate money towards it? It could also mean the search for grants and other federal money sources. Also, according to the interviewees the general public basically has to decide whether or not they want the plan, and if they do, they need to start advocating for it.

9.1 Results of Analysis

In general it can be concluded that only making additions to the plan, like adding an action plan for the stakeholders or adding more scientific background, will not be enough. Structural changes towards policy, legislation and the organizational structure are necessary to insure good implementation and maintenance afterwards. Assigning responsibilities and maybe even changes in the current jurisdiction of some entities, making policies and legislation that incentivize implementation of the Urban Water Plan and enforcing this legislation, and finding a way get every stakeholder around the table, which perhaps can be done in the form of a board.

Communication is a very important aspect. Communication in the form of outreach to the general public to get buy-in. Communication to remove some of the issues and uncertainties that the stakeholders have, which for most part can easily be solved by including experts and engineers in the discussion. And, after some of the demonstration projects are implemented, communication to

the general public on how it works shows that it is a true alternative for the current grey infrastructure and education for the stakeholders to learn from the demonstration projects, either to do it better next time or to implement more since it proves to be a solid method.

Another aspect that came up frequently during field research and is very important is commitment. When the Urban Water Plan was presented on September 6th important elected officials of all parishes, expressed their support towards the plan. Next steps from local government which shows their commitment now need to be taken, for example adjusting policies and legislation and implementing the proposed demonstration projects. Besides the changes in the Comprehensive Zoning Ordinance of Orleans Parish and parts of the Urban Water Plan in the draft version of the comprehensive plan in St. Bernard, no concrete steps have been taken, or statements have been made towards the implementation of the demonstration projects. The commitment of each of these entities and elected officials will be crucial for the implementation of the plan if no changes are made in the organizational structure like an overall water management entity or board.

9.2 Research Approach

The methods that have been used in the thesis have proven to be quite useful. The chain model is a good tool to identify constraints. Even if it is quite straightforward, it clearly makes a difference between each part that might need to be adjusted and followed through in order to make implementation possible and successful. The addition of politics to the chain model was necessary in the case of the Urban Water Plan since it has not been developed by the entities that are responsible for policy, the first step of the chain model.

The SWOT analysis provided insights for changes within the plan, and therefore complemented the chain model approach. The chain model focuses more on the process, where the outcome of the SWOT analysis showed more opportunities and constraints within the plan.

The MCDA was used to see if it was possible to make a prioritization of the elements and in the future perhaps to make prioritization of the projects. It showed that a different approach for each of the parishes could be a solution for implementation and it can be useful to use the MCDA to make a prioritization for each of the parishes. ELECTRE III is a tool that is easy to use for stakeholders. Where other tools might need a lot of input (like for example ARGUS) to come to an outranking or other methods use data collection models that are difficult to understand for interviewees (like for example AHP) or make use of quantitative data instead of qualitative data, ELECTRE III does not require too much data from the interviewees and takes a short amount of time. The results of ELECTRE III provide clear input to final decision making on priorities with the stakeholders.

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Appendix A: Climate in New Orleans

New Orleans has a warm humid temperate climate with hot summers and no dry season, as can be seen in Figure 15. This type of climate makes for a very long growing season, approximately 300 days (America's Wetland Foundation Resource Center, 2012), and is favorable for mosquitoes (Reisen, Cayan, Tyree, Barker, Eldridge, & Dettinger, 2008). It is one of the wettest cities in the United States, with an

average of 160 centimeters (62 inches) of rainfall each year. Most of the rain falls in intense bursts, which can be as much as 15 centimeters (6 inches) in one hour. Thunderstorms and intense rainfall is most common in the summer months. Isolated showers can inundate one area, while other areas in the region stay dry. Figure 14 illustrates a 100 year rainfall event in 1995 and it can be seen that the differences in rainfall are quite large across the region. It is not uncommon for one neighborhood to experience some drizzle while a nearby neighborhood suffers from a street flooding (Waggoner & Ball Architects, 2013).

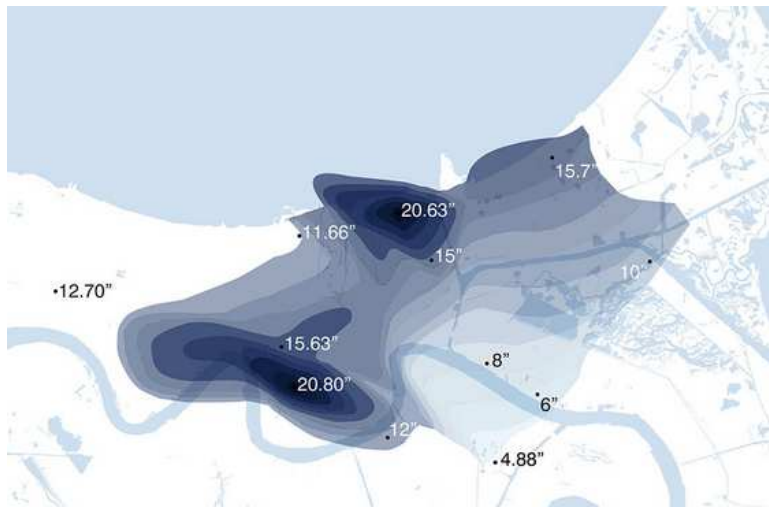


Figure 14: Rainfall even in New Orleans on May 8, 1995 (source: www.livingwithwater.com)

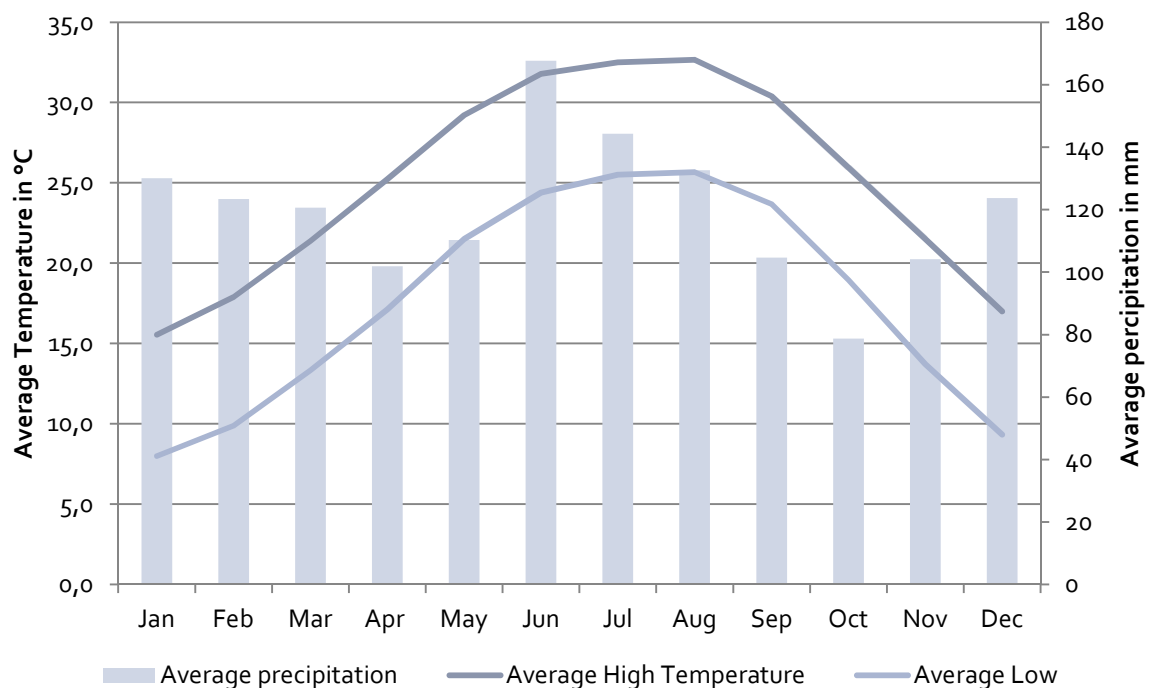


Figure 15: Average yearly temperature and precipitation from 1981-2010 (source: National Climatic Data Center)

Appendix B: Greater New Orleans Urban Water Plan

In 2010, the state of Louisiana's Office of Community Development Disaster Recovery Unit funded Greater New Orleans, Inc. (GNO, Inc.) to develop a comprehensive, integrated and sustainable water management strategy for St. Bernard Parish and the east banks of Orleans and Jefferson Parish. In March 2011 GNO, Inc. chose Waggonner & Ball Architects for this assignment. Over a course of two years Waggonner & Ball and a team of local and international, including Dutch, water management experts developed the plan. The Greater New Orleans Urban Water Plan (UWP) addresses flooding caused by heavy rainfall and soil subsidence caused by the pumping of groundwater. Besides these two issues it takes into account the opportunities at hand to use the water resources (functionally, aesthetically and ecologically) in order to build resiliency and improve the quality of life in the communities on the East Bank of the Mississippi River in Jefferson, Orleans, and St. Bernard Parishes. The major goals of the UWP are to increase safety, provide economic opportunity, and improve quality of life. It provides a new approach to water management in New Orleans by reintroducing water into the city and introducing multiple lines of defense, which already is a foundational principle for all Louisiana coastal planning. Even though New Orleans is surrounded by water, it is nowhere to be found in the city.

Principals

The new vision for New Orleans is based on six principles:

- **Live with water.** New Orleans is situated in a delta where water is a fact of life. To make it an asset to the city once again, space is going to be made and it will be made visible in the urban landscape.
- **Slow and store.** Due to all the impervious area in the project area water travels fast and is therefore difficult to manage. By holding it where it falls, slowing down the flow and storing large volumes of rainfall for infiltration and other purposes makes it much easier to manage and makes the pump stations a smaller liability. Pump stations then don't have to be activated every time it rains.
- **Circulate and recharge.** In a natural situation surface waters and groundwater move across and within a delta. By restoring this process within the urban area by incorporating surface water flows and higher water levels, groundwater balance, water quality and the ecological health of the region will be improved.
- **Work with nature.** The typical and diverse flora and fauna of the region are very good at storing, filtering and growing with water. Integrating these natural processes will enhance the function, beauty and resilience of the region's water infrastructure and landscape.
- **Design for adaptation.** Change is a constant in the delta. Systems should be designed for dynamic conditions and should support diverse uses, economic development, and environmental restoration to maximize the value of necessary water infrastructure investments.
- **Work together.** Water is not bounded to jurisdictions, which makes collaborations across neighborhood, cultural and political boundaries necessary as well as developing solutions at different scales, from individual properties to regional networks. This is a requirement for building a stronger future.

Project Areas and Demonstration Projects

All these principals come together in the projects that are designed for the eight smaller project areas that situated within the big project area of the three parishes, see Figure 16. Within and along these project areas the Urban Water Plan has developed designs for the basins (low-lying area surrounded by levees or floodwalls with water on the other side, also know in the Netherlands as a polder), design districts (group of neighborhoods bounded together by major infrastructure and natural features), demonstration projects (design proposal that applies water management principles at the scale of individual properties) and urban opportunities.

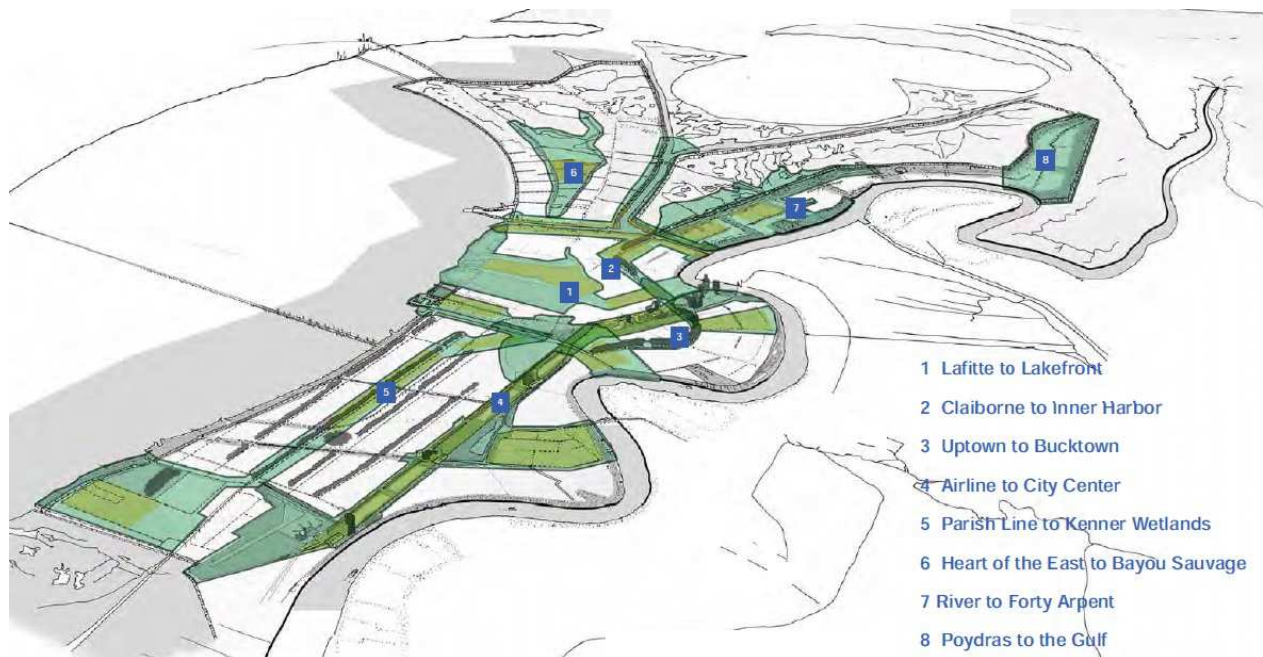


Figure 16: Project areas within the Urban Water Plan

The bigger project area consists of three hydraulic or catchment basins which have boundaries and landscape features that influence water and urban design relationships: the Jefferson-Orleans Basin, the Orleans East Basin, and the St. Bernard Basin (which includes a small portion of Orleans Parish).

Within each smaller project area, which is shown in Figure 16, there are design districts, demonstration projects and urban opportunities. Where the design districts and the urban opportunities are more visionary and for the mid-long to long-term implementation, the demonstration projects are meant for short-term implementation and are meant to learn and show the public and stakeholders how different water management principals work in practice. There are a seven demonstration projects in total. These are described on the next page.

Mirabeau Water Garden



Situated in Lafitte to Lakefront, the Mirabeau Water Garden is a privately-owned suburban site. The project includes capturing water from the drainage system, treating water and storing it for educational and recreational use.

Lafitte Blueway



Situated in the project area Lafitte to Lakefront, the Lafitte Blueway consists of a two-mile linear park white a dilapidated canal. The project is aimed at developing a circulating waterway that will recharge the system and provide stormwater storage for surrounding neighborhoods.

Lakeview Floating Streets



The Lakeview area is situated in Uptown to Bucktown and suffers from subsidence issues which have caused damage to buildings and homes, as well as the streets and utilities. A comprehensive street design with underground storm water storage and pervious pavement should balance the groundwater levels and stabilize the infrastructure.

Elmwood Fields and Water Lanes



Situated in Airline to City Center, this area in Jefferson Parish is primarily an industrial business park with mostly paved, impermeable areas and very little vegetation. The design aims to slow down and store the runoff by implementing vegetative bioswales, permeable paving, tree planting, and green roof tops.

Canal Street Canal



The Canal Street Canal is situated in Parish Lines to Kenner Wetlands. It is a small neighborhood canal with a manually operated gate, allowing water levels and infiltration scenarios to be tested in an isolated system. The goal is to increase water storage capacity and groundwater recharge, as well as improving the aesthetic quality and transforming the corridor into a neighborhood asset and amenity.

Eastern Water Walk



The Eastern Water Walk is situated in Heart of the East to Bayou Sauvage and integrates a system of stormwater collection throughout the existing and proposed commercial development. By adjusting the boulevard's right-of way to allow for designated bicycle and pedestrian areas, and adding bioswales on either side of the street will turn the area into a major stormwater corridor and an asset for the neighborhoods.

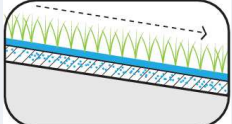
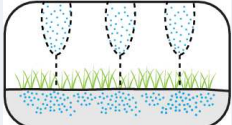
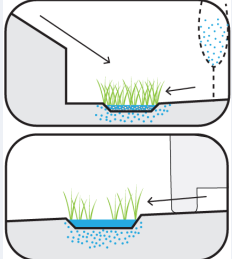

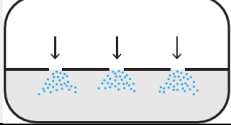
Forty Arpent Canal Zone

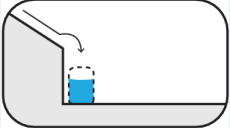
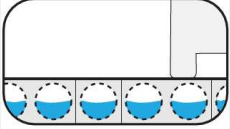
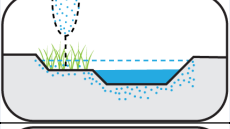
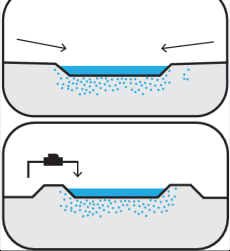
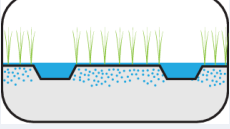
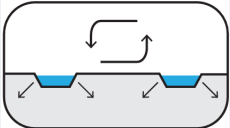
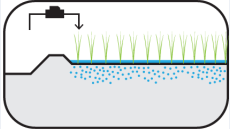


This demonstration projects, which is situated in River to Forty Arpent project area, aims to meet water storage and subsidence control objectives by re-designing the canal and thereby changing the area into a nice destination landscape for residents and visitors.

Water Management Elements

The Urban Water Plan makes use of 12 water management elements, which are each used in the different demonstration projects. The elements are all part of the principles to slow, store and use or circulate and recharge the water instead of draining as a first measure. The elements are the following:

| | | |
|---|---|---|
| Green Roofs |  | A roof system of soil media and vegetation that helps to absorb and store stormwater that falls on the roof. Green roofs lessen roof runoff, improve water quality, and reduce heat gain through evapotranspiration. Principle: SLOW |
| Plants |  | Plants and trees can capture water and slow down the process of water going into the drainage system. Part of the water that fall on plants and trees is evapotranspired. Principle: SLOW |
| Bioretention & Infiltration <i>(Rain Gardens and Bioswales)</i> |  | Stormwater is collected into an area which can consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. Runoff first passes over a sand bed, which slows the runoff's velocity, distributes it evenly along the length of the ponding area, which consists of a surface organic layer and/or groundcover and the underlying planting soil. Water gradually infiltrates the bioretention area or is evapotranspired. The bioretention area is graded to divert excess runoff away from itself. Stored water in the bioretention area planting soil exfiltrates over a period of days into the underlying soils. Infiltration replenishes groundwater and raises the water table. Principle: SLOW |
| Exfiltration |  | Exfiltration basins are a redesign of typical catch basins and manholes found throughout the region. The basins enable water to gradually enter the groundwater system through a pervious bottom and a spread aggregate base. A system of these basins provides for a distributed method of recharging groundwater. (UWP) Exfiltration is the 'loss' of water from a drainage system as the result of percolation and absorption into the surrounding soil. Principle: SLOW |
| Pervious Paving |  | A material for walkways, roadways, and parking lots that allows stormwater to be absorbed by the ground where it falls, reducing runoff into the drainage system. Principle: SLOW |

| | | |
|---|---|--|
| Water Harvesting |  | The accumulation and deposition of rainwater for reuse before it reaches the ground or drainage system. Principle: SLOW |
| Subsurface Storage |  | The portion water that penetrates into the soil and stagnates for a short period of time or for many years. Principle: SLOW |
| Improved Canal |  | An existing canal that has been renovated to widen its banks and provide a stepped platform, where possible, that can serve as an inviting public space during dry weather and as extra water storage during heavy rains. Principle: STORE & USE |
| Storage Basin <i>(Excavated Basin and Leveed Basin)</i> |  | An excavated area installed on, or adjacent to, the canals in the project area to protect against flooding. During normal weather conditions these basins will be empty/dry and can be used as recreational areas. During extreme conditions they offer a relief to the canals the adjacent neighborhoods. Principle: STORE & USE |
| Constructed Wetland |  | An artificial wetland created as a new or restored habitat for native and migratory wildlife, for anthropogenic discharge such as wastewater, stormwater runoff, or sewage treatment, for land reclamation after mining, refineries, or other ecological disturbances such as required mitigation for natural areas lost to a development. Natural wetlands act as a biofilter, removing sediments and pollutants such as heavy metals from the water, and constructed wetlands can be designed to emulate these features. Principle: STORE & USE |
| Circulating Network |  | A connected system of canal where water is pumped out only when necessary, allowing water to circulate and groundwater to recharge, while maintaining beautiful waterways throughout the project area. In dry times, siphons can replenish water levels in the canal system by pulling water from outlying sources. (UWP) Principle: STORE & USE and CIRCULATE & RECHARGE |
| Redirected Discharge <i>(External Wetlands)</i> |  | A strategy that provides a shorter drainage route by redirecting some of the discharge to the river, the Industrial Canal, and the natural wetlands. This will relieve currently overloaded canals, allow for raised water levels in proposed circulating networks, and contribute to wetland restoration. Principle: CIRCULATE & RECHARGE |

Cost-Benefit Analysis

An economic cost-benefit analysis was done on the Urban Water Plan. The expected costs for implementation of the plan are \$6.2 billion. The impact of 50 years will give a reduction of \$8 billion dollars for flood damages, \$2.2 billion for subsidence damage, \$609 million in insurance premiums and an increase of \$183 million in property values. It has also been estimated that it will have regional economic impact of \$11.3 billion due to the amount of activity in the supporting industry sectors and creating jobs.

Appendix C: Interview

Before the interview

- Introduction on what I do, why I want to do this, what the goal of the interviews is.
- Use of voice-recorder

General

1. Can you give a general description of what your department/company/organization does?
2. What is your function in the department/company/organization?
3. Have you heard of the Greater New Orleans Urban Water Plan, and what do you think of the Plan?
4. What has your role been so far in the Greater New Orleans Urban Water Plan?
 - a. What role did you want to play with regards to the Greater New Orleans Urban Water Plan?
5. How do you rate yourself with regards to the Urban Water Plan for the following:
High/Medium-High/Medium/Low-Medium/Low
 - a. Interest in the Urban Water Plan
 - b. Influence (power) on the Urban Water Plan
Impact of the Urban Water Plan on the
 - c. stakeholder
6. How do the criteria of the Urban Water Plan relate to your priorities/priorities of the department/company/organization?
 - a. How important are the criteria of the Urban Water Plan?
Divide 100% over the 6 criteria

| | |
|------------------------------------|---|
| i. Provides multi-level protection | iv. Attracts & retains businesses and investments |
| ii. Reduces flood risk | v. Increases citizens quality of life |
| iii. Limits subsidence | vi. Enriches ecosystems |
7. Have you or your department/company/organization already taken concrete steps towards implementation (of aspects) of the Urban Water Plan?

Strengths/Weaknesses

8. What are the strengths of the Urban Water Plan?
 - a. What benefits does the Urban Water Plan contain for your department/ organization?
 - b. What opportunities does the Urban Water Plan have for you department/ organization?
9. What are the weaknesses of the Urban Water Plan? Are there elements missing?
 - a. What disadvantages does the Urban Water Plan have for your department/organization?

Constraints

10. What constraints do you see towards implementation with regards to your department/company/organization?
11. What constraints do you see towards implementation in general?
 - a. Constraints in policy?
 - b. Constraints in legislation?
 - c. Constraints in implementation?
 - d. Constraints in maintenance and control?
Constraints in
 - e. organization?

Lakeview Floating Streets (only if it is a stakeholder for the pilot area or relevant for Floating Streets)

12. What specific constraints do you foresee in this pilot area/type of project?
13. What are the other stakeholders in this pilot area? (Only if a stakeholder)
How important are these stakeholders for the implementation of the Greater New Orleans Urban
14. Water Plan? (Only if a stakeholder)

Locations

15. Are all the locations in the Urban Water Plan equal in how important they are? If not, why and could you try to rank the different locations? Is this Urban Water Plan necessary for all the neighborhoods that are mentioned? How about in your own parish?
Rank 1 to 8
 - a. Lafitte to Lakefront
 - b. Claiborne
 - c. Uptown to Bucktown

- d. Airline to City Center
- e. Parish Lines to Kenner Wetlands
- f. Heart of the East to Bayou Sauvage
- g. River to Forty Arpent
- h. Poydras to the Gulf

Round-up

- How do you want to be referred to in my master thesis?
- Can I contact you if I've got any remaining questions? There might be some constraints that will be identified that haven't been ranked no in the MCDA.
- Would you like to receive my thesis, after I have finished?

Follow Up

1. Can you rank how important the different constraints are?
Divide 100% over the 6 criteria
 - a. Buy-in from the general public
 - b. Project areas are to developed or are in private areas
 - c. Unclear responsibility (of who should do implementation and/or maintenance)
 - d. Lack of coordination between different entities (getting all the parties to the table)
 - e. Change culture or mindset of the stakeholders or entities
 - f. Funding
2. How do you rank the different actions with regards to the constraints?
1 to 5
 - a. Plants
 - b. Bioretention & Infiltration
 - c. Exfiltration
 - d. Pervious Paving
 - e. Subsurface Storage
 - f. Circulated Flow
3. Can you rank how important the different principals are?
 - a. Live with water
 - b. Slow and store
 - c. Circulate and recharge
 - d. Work with nature
 - e. Design for adaption
 - f. Work together

Appendix D: Survey

Age

Gender

Profession

How long have you lived in New Orleans?

How long have you lived in this neighborhood?

What do you know about water management?

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What do you know about subsidence?

| |
|--|
| |
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What do you know about the storm water drainage system in New Orleans?

| |
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|--|

Have you heard about the Greater New Orleans Urban Water Plan?

Yes / No

Where did you hear about it?

| |
|--|
| |
|--|

What are your thoughts about it?

| |
|--|
| |
|--|

How important are the following principals to you on a scale from 1 to 5?

a. Live with water

1 / 2 / 3 / 4 / 5

b. Slow and store

1 / 2 / 3 / 4 / 5

c. Circulate and recharge

1 / 2 / 3 / 4 / 5

d. Work with nature

1 / 2 / 3 / 4 / 5

e. Design for adaption

1 / 2 / 3 / 4 / 5

f. Work together

1 / 2 / 3 / 4 / 5

One of the demonstration projects that are being discussed is the floating streets. These streets contain different elements. How supportive are you of these elements?

a. Pervious paving

1 / 2 / 3 / 4 / 5

b. Bioretention & infiltration

1 / 2 / 3 / 4 / 5

c. Plants

1 / 2 / 3 / 4 / 5

d. Subsurface storage

1 / 2 / 3 / 4 / 5

e. Exfiltration

1 / 2 / 3 / 4 / 5

Appendix E: Glossary

Amoeba Parasite

In August of 2013 a 4-year-old child in St. Bernard died after a brain-eating amoeba infection (Bonifield, 2013). The amoeba parasite, or more specific, the *naegleria fowleri*, is a single-celled organism which is most commonly found in warm, wet places like mud puddles, untreated swimming pools and spas, or untreated well water or untreated municipal water. *Naegleria* can't live in salt water and water that has been treated with chlorine (Centers for Disease Control and Prevention, 2013). Right after the incident St. Bernard started flushing their drinking water system with high doses of chlorine, but the amoeba parasite was never came up in test results of the drinking water in the system. It was believed by the municipality that it never actually was in the drinking water system, but in the hose or tap that was connected to the system (Nunez, 2013).

Clean Water Act

The Clean Water Act (CWA) is federal legislation, which goal is to restore and maintain the chemical, physical and biological integrity of the water bodies of the United States. The long-term goal is to eliminate polluted discharge into surface waters, but currently it is focusing more on the goal of attaining swimmable and fishable waters. It started as the Federal Water Pollution Control Act in 1948 and was revised in 1972, to give it a stronger regulatory, water chemistry-focused basis to deal with acute industrial and municipal effluents that came up in the 1970s. Amendments in the 1987 broadened the focus to deal with more diffuse sources of impairments, including stormwater. Improved monitoring over the past two decades has documented that although discharges have not been eliminated, there has been a widespread lessening of the effects of direct municipal and industrial wastewater discharges. While the purpose of the CWA is to ensure protection of physical, biological and chemical integrity of the U.S. water bodies, the enforceable reach of the Act extends only to the discharges of pollutants. Therefore, the focus of the CWA with respect to stormwater has traditionally been on the water quality of stormwater and not on its quantity, timing or other hydrologic properties. The U.S. Environmental Protection Agency (EPA) is responsible for the execution of the CWA (National Research Council, 2009).

Comprehensive Zoning Ordinance

The Comprehensive Zoning Ordinance (CZO) is the law that oversees land use throughout the parishes. Each of the parishes has its own CZO. The CZO includes lists of permitted land uses for the different zoning districts, and also includes all kinds of regulation like height limits and urban design standards (City of New Orleans, 2013).

MS4 Permit

The National Pollutant Discharge Elimination System (NPDES) program is part of the CWA and is used to regulate the quality of the nation's water bodies. In 1987, to address the role of stormwater in causing or contributing to a reduction of water quality, Congress wrote Section 402(p) of the CWA, bringing stormwater control into the NPDES program, and in 1990 the EPA issued the Phase I Stormwater Rules. These rules require NPDES permits for operators of municipal separate storm sewer systems (MS4s) serving populations over 100,000 and for runoff associated with industry including construction sites five acres and larger. These NPDES permits are also known as the MS4 permits. In 1999 EPA issued the Phase II Stormwater Rule to expand the requirements to small MS4s and constructions sites between one and five acres in size. To comply with the CWA regulations,

industrial and construction permittees must create and implement a stormwater pollution prevention plans, and MS₄ permittees must implement a stormwater management plan (National Research Council, 2009). All three parishes in the project area require an MS₄ permit.

Stormwater Control Measures

The stormwater pollution prevention plans that are required for the MS₄ permit need to make use of stormwater control measures (SCMs) that will be used to prevent stormwater coming from these sources from degrading nearby water bodies (National Research Council, 2009). The SCMs (also known as best management practices or BMPs) range from structural methods such as detention ponds and bioswales to nonstructural methods such as designing new development to reduce the percentage of impervious surfaces (U.S. Environmental Protection Agency, 2010).

Stormwater Rule by the EPA

The U.S. Environmental Protection Agency is developing new national rulemaking with regards to stormwater discharges. Its objective is to reduce stormwater discharges from newly developed and redeveloped sites and make other regulatory improvements to strengthen its current stormwater program as it is stated in the Clean Water Act (U.S. Environmental Protection Agency, 2013). This rulemaking is still under consideration and it might include performance standards that could vary according to an area's climate and other location-specific characteristics and require sustainable stormwater controls. They are also looking at options for expanding the protection of the MS₄ program and how it could encourage watershed approaches for managing municipal stormwater discharges (U.S. Environmental Protection Agency, 2013).