



Te Awarua-o-Porirua Harbour: Assessing Community Awareness and Analyzing Methods to Reverse Pollution

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1. Introduction

Harbors are an attractive and important area for human habitation due to their access to land and sea, and the opportunities for trade and urban development. But those very qualities often lead to the pollution of the water bodies. Many cities, like Beijing, China and New York City, United States, are currently faced with polluted waterways and are investing millions of dollars into treating wastewater and preventing sewage spills (BBC, 2006). Heavy rainfall burdens cities by flooding wastewater treatment facilities and causing public alarm (AP, 2013). There are numerous approaches to battling aquatic pollution that coastal towns and cities are implementing to abate the world-wide pollution issue. Decades of pollution may take generations to reverse, but several government agencies and local organizations are focusing on curbing their regions' pollution problems.

Te Awarua-o-Porirua Harbour is central to the city of Porirua in the Greater Wellington Region of New Zealand. It is a focus of tourism in the area and its shores host most of the city's urban development. Members of the local Maori tribe, the Ngati Toa, claim that before the development of the harbor, the area was a "natural food basket" for local iwis (Dominion Post, 2013). Boating, swimming, and fishing were common in the harbor until the Porirua City Council discouraged those activities through numerous health warnings in 2013 (PCC, 2015). Local groups claim that it may take an entire generation to restore the harbor to its natural state (Dominion Post, 2013).

The Greater Wellington Regional Council and the Wellington and Porirua City Councils are currently working with the Porirua Harbour and Catchment Community Trust and several other community groups to restore the health of Te Awarua-o-Porirua Harbour through a series

of action plans. A study by the Ngati Toa aiming to monitor and better understand the pollution in the harbor is currently underway as well. Other groups are working to encourage better communication between stakeholders and standardizing monitoring methods. While no immediate or permanent solution for cleaning up the harbor is likely in the long term, stakeholders are taking the initiative to solve the pollution issue (PCC, 2012).

Our project team will be working with the Greater Wellington Regional Council to analyze the issues impacting Te Awarua-o-Porirua Harbour and to provide recommendations to the Council. In addition to listening to the concerns of the Greater Wellington Regional Council, our team must also consider the community of Porirua. With stronger community awareness and engagement, the residents of the Greater Wellington Region may be able to take strides to reduce household and private pollution in Porirua's Harbour. Our team will conduct an analysis of the community's knowledge of pollution and its willingness and ability to act more sustainably so that our recommendations may be feasible in terms of cost and practicality.

Our research goal is to recognize the sources of pollution in Te Awarua-o-Porirua Harbour, gauge community interest and activity in restoring the harbor, and to recommend potential solutions to reverse pollution damage. Once we understand the community's willingness and ability to restore the harbor to a healthy state we will be able to develop solutions that compromise and take into account the concerns of all parties to propose to the Greater Wellington Regional Council. We aim to provide the Regional Council with an array of cost-effective and low impact solutions that will reduce current levels of pollution in the harbor and impede future pollutants.

2. Background

2.1 Overview

Recently the city of Porirua, located in the Greater Wellington Region of New Zealand, officially declared Te Awarua-o-Porirua Harbour unsafe for recreational use (Calder, 2015). A history of ecological misuse has led to the area's fading natural beauty and fleeing if not dying wildlife. This creates a matter of concern to the region's citizens. As the harbor is one of the most prominent landmarks of Porirua, its continued degradation is hurting tourism in the city, along with the health and happiness of the community members within it. Prior to the city council declaring the harbor unsafe in 2013, it was an ideal spot for aquatic activities when visiting the Wellington region (Dominion Post, 2013). This is why the restoration process of the harbor began.

There are many aspects relative to the harbor that our team needs to understand in order to continue the restoration process. To begin, it is important to know the history of Te Awarua-o-Porirua Harbour and how years of misuse have led to its current polluted state. This also includes what types of harmful contaminants are specifically mixed into the harbor at this point in time. It is also important for our team to understand the negative social impacts the pollution has on Porirua. This background chapter additionally researches the goal that the city of Porirua is trying to accomplish through its various action plans, along with the key stakeholders involved in the restoration process. Reviewing other water bodies and how they are managed regarding pollution is the final topic our team will study before moving forward. Knowing these details establishes a basis from which to study the problems affecting the harbor and how they will

require technology and community involvement to restore an important attraction of the Greater Wellington Region.

2.2 Porirua and Te Awarua-o-Porirua Harbour

2.2.1 History of Settlement and Progress of Pollution

In the fifteenth century Maori settled around Te Awarua-o-Porirua Harbour due to its abundance of marine life and surrounding beauty. In the early nineteenth century the British also began to settle around the harbor. During this time, as modern civilization began to grow, the harbor waters began to degrade. As urban society created infrastructure in the area, relocated sediment began to fall into the harbor. Foreign sediments would drain into the harbor's ecosystem disrupting the environment that previously existed. During this century of development, wildlife began to relocate as their habitats were no longer suitable for their survival (Trust, 2013). In the mid twentieth century, during an era of near-modern consumption practices, litter and other non-organic pollutants began to contribute to the pollution of the harbor. Aside from everyday waste products and debris, all storm drains emptied unfiltered liquids into the harbor. This led to anything that was previously on the streets accumulating within the harbor. Specific examples of these pollutants are fluids from vehicles, soaps, cleaning chemicals from car washing, and any other inorganic products found in an urban environment that does not belong in aquatic ecosystems (PCC, 2015).

2.2.2 Geographic Location and Demographics

Porirua City is one of four cities located in the Greater Wellington Region. Lying on the southwestern coast of the North Island in New Zealand, it completely surrounds a small body of water previously known as "Porirua Harbour." As of 2014, the official name of the harbor is "Te Awarua-o-Porirua Harbour." Porirua City Council modified the name with the intentions of acknowledging the Maori roots of the harbor body and its importance to all residents in the region (PCC, 2015). There are two main sections that make up the harbor, the Pauatahanui Inlet and the Onepoto Arm, in addition to an outer harbor section and catchment areas that span the city of Porirua. Figure 1 depicts a map of the Greater Wellington Region and the harbor's catchment areas.

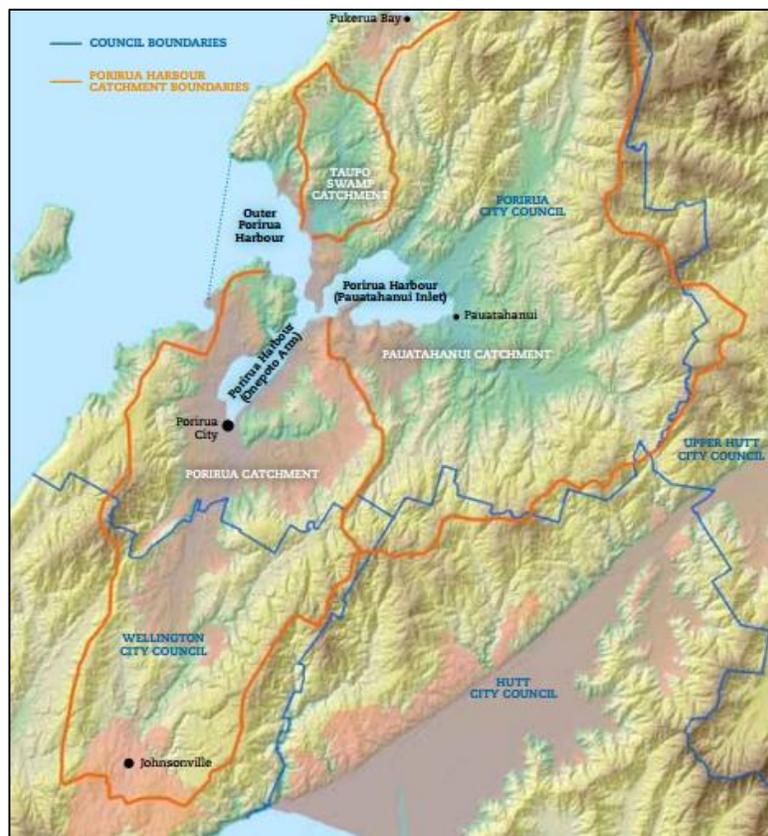


Figure 1. Map of the Greater Wellington Region and Te Awarua-o-Porirua Harbour (PCC, 2012).

As of the 2013 New Zealand census, Porirua City has a population size of 51,700 people. Roughly 20% of the population is Maori. In terms of finances, the median income in Porirua per individual above the age of fifteen is 31,400 NZ\$. Additionally, 31% of the total population has an annual income of over 50,000 NZ\$ while 9.3% are unemployed (Census, 2013). Porirua City has urban and rural districts throughout. In general, the urban areas are all coastal and are surrounding the majority of the harbor, while the rural areas are further inland and are for agriculture and development of future dwellings. Within the city, 90.9% of households are one person or single family homes. The 2013 New Zealand Census did not specify the location of these households, or whether they were privately owned apartments or single homes (Porirua City Profiles, 2013).

2.3 Sources of Pollution in the Harbour

2.3.1 Current Pollution in Porirua

Urbanization of the city of Porirua has led to increasing pollution in Te Awarua-o-Porirua Harbour. The National Institute of Water & Atmospheric Research claims that the past 50 years have seen an increase in bacteria and other pollutants entering the harbor. Before drastic development of the city, the harbor was a “natural food basket” for the residents. Now, the shellfish caught in the harbor are not safe for eating and pollutant levels are only safe 80 percent of the time in the summer months for recreational activities. In 2012, the amount of bacteria in the harbor rose to three times the safe limit for swimming (Dominion Post, 2013).

The pollution levels in the Porirua Harbour reaching critical levels has rendered the harbor unsafe for fishing, swimming, and recreational use. In order to address the issue of

pollution in the harbor it is important to identify the sources of pollution. By identifying the sources, bylaws, and regulations currently in place to minimize continued pollution our team can more effectively target our efforts.

2.3.2 Stormwater Drains

The storm drains in Porirua City lead to Te Awarua-o-Porirua Harbour, which has the unfortunate side effect of transporting any debris and chemicals caught in the drains into the harbor. This was one of the chief reasons behind a controversial ban on washing cars in driveways, which section 2.6.1 in this paper later addresses. Concern over contaminants entering the harbor through the storm drains prompted the Porirua City Council to pass a bylaw banning car washing as a way to control the pollutants (Hunt, 2015). This bylaw highlights the broader problem of the storm drains as other pollutants more harmful than soapy residue from car washing end up in the harbor. As of 2009, experts found high concentrations of fecal matter, lead, copper, zinc, and DDT in the harbor with the storm drains being one of the main culprits for their entry (Callman, 2009). To help address these problems the Porirua City Council passed a stormwater bylaw in August of 2015. This law prohibits the dumping of cleaning products and agents such as detergent, disinfectants, and bleach into the storm drains along with other harmful chemicals such as water blasting waste, paint, solvents, liquid fuels, radiator coolant, cooking oil, cement wash, slurry, and concrete cutting waste.

2.3.3 Construction Development

Construction is one of the top five industries in Porirua, employing 8.3% of the city's population as of 2013 (Census 2013). Due to this industry, the development of Porirua and the surrounding Porirua Basin produces large amounts of sediment that are then washed into the

harbor. Over the past 160 years sediment from the development of Porirua has been accumulating in the harbor. In the past 30 years, the layer of sediment in the Pauatahanui Inlet may have risen by as much as a meter. This buildup of silt in the harbor raises the seabed, making the water shallower, and kills sea life through contaminates and by smothering them under sediments. The deterioration caused by this prompted the Porirua city council to pass The Resource Management Act of 1991 and later, the Building Act 2004. These bylaws regulates the amount of sediment that enters the harbor due to construction (PCC, 2008). Despite these measures large amounts of sediments are still entering the Harbour. In 2009, an article from the Dominion Post Jim Lohead, a general manager for the Carrus Corporation, a land developer in Porirua, stated that “Despite erosion and sediment-control plans, and developers working to those plans, we are still getting too much sediment coming off the sites” (Callman, 2009).

2.3.4 Sewage Spills

The Porirua City Council maintains control of the local wastewater treatment plant, depicted in Figure 2. Prior to the plant's commission, a comminutor¹ chopped up wastewater from Titahi Bay on the west coast of Te-Awarua-o-Porirua Harbour and discharged it to the sea. However, since the plant's opening in 1990 there have been reports of raw sewage water ending up on the shores of Titahi Bay (PCC, 2003). In 2011 the Porirua City Council carried out a 4.5 million NZD upgrade to the plant. This was to help solve the problem where instances of heavy rainfall would overflow the plant, causing the plant to release raw or partially treated wastewater to into the sea. The upgrade, a third large (40-meter diameter) clarifier installed on site would be able to contain 1350 liters of wastewater, nearly double the previous capacity of the plant. In theory, this

¹ A *comminutor* is a waste treatment machine that is used to pulverize solids.

addition would have helped the plant handle the increased water flow caused by heavy rainfall, thus lowering the risk of wastewater spillage (Smith, 2011). However, despite the addition of the new clarifier, spillage continued to occur. In 2012 a large sewage spill sent wastewater into Titahi Bay (Johnstone, 2014). Again in 2014 the Porirua City Council invested nearly 40,000 NZD towards the cost of restoring a local stream contaminated by spillage from the wastewater treatment plant (Smith, 2014).



Figure 2. Porirua wastewater treatment plant (GWRC, 2014).

2.3.5 Rubbish Dumping

Rubbish dumping has been a problem in Te Awarua-o-Porirua Harbour for some time. Despite the Porirua City Council considering the littering and dumping of rubbish a form of vandalism punishable by a fine of up to 5,000 NZD, tires, shopping trolleys, and other bits of trash keep showing up in the harbor in alarming volumes (PCC, 1979). The constant littering has created a “sea of unsightly trash” in the harbor (Dominion Post, 2009). This sea of tires and other forms of rubbish is viewable from the city at low tide, and in the opinion of Keith Calder, a

harbor strategy coordinator, the rubbish “reinforces a perception that it is acceptable to throw things into the harbor” (Calman, 2009). Additionally, the recent bankruptcy of The Mana Recovery Trust, a non-profit organization, has led to the closure of the local Trash Palace that operated under the trust’s direction. The Trash Palace performed recycling collection services for Porirua. With the sudden loss of the only recycling center in the area, the Porirua City Council has told residents to send unwanted household goods to any second hand shops or to donate them to Kiwi Community Assistance donation bins (PCC, 2015). This lack of a centralized method of recycling could lead to more people simply dumping their trash into the harbor as a more convenient alternative to the options presently offered.

2.3.6 Upstream Runoff

Porirua Stream feeds into Te Awarua-o-Porirua Harbour’s lower arm, as shown in Figure 3. Porirua Stream is one of the most important streams in the urban Wellington Region, running from Johnsonville to Porirua with its drainage basin spread over 5,600 hectares (APW, 2009). A system of smaller streams feeds into the larger Porirua Stream. One of the streams, Mitchell Stream, has had pollutants detected within it. Mitchell Stream flows through the Mitchell sub-catchment as shown in Figure 3. Experts have detected chemical residue in the stream as early as 2009 when residents notified environmental protection officers of foam in the water. While the exact source of the pollution was not formally identified, the locations through which the stream flows puts it at an increased risk of pollution. These pollutants travel through Mitchell Stream into Porirua Stream, ultimately ending up in Te Awarua-o-Porirua Harbour (GWRC, 2009).

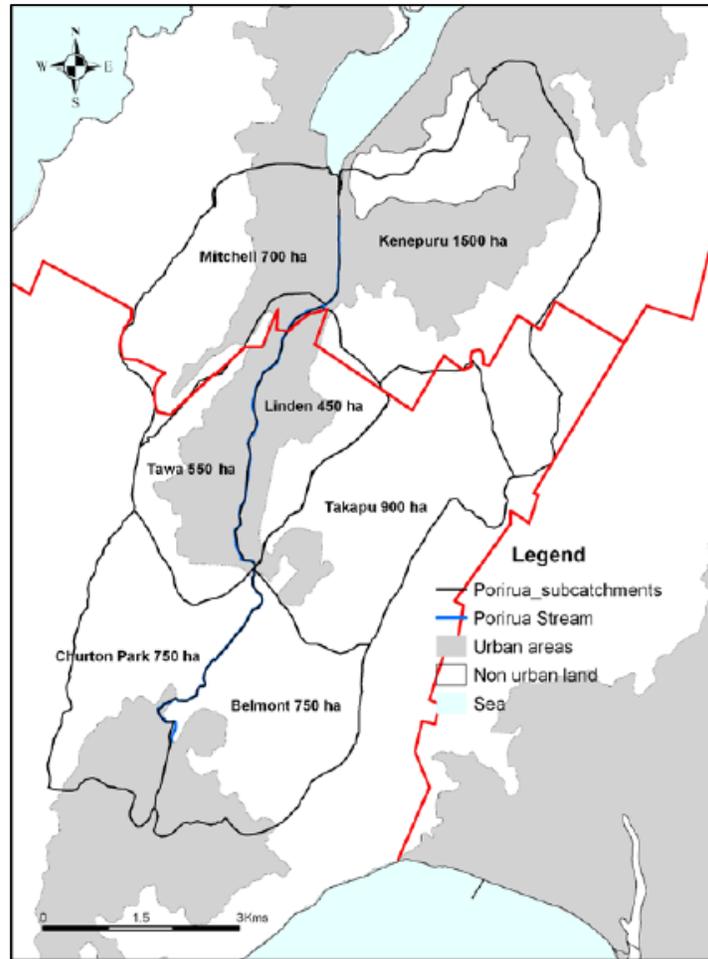


Figure 3. Porirua Stream and sub-catchments (GWRC, 2015).

2.4 Current Policies and Action Plans

2.4.1 National Policy Statement for Freshwater Management 2014

The Ministry for the Environment introduced its National Policy Statement for Freshwater Management 2014 on August 1, 2014. The statement addresses the unsuitable water qualities throughout the Greater Wellington Region and the rest of the nation. It suggests implementations to bring the water qualities up to an established standard. The Ministry defines the national bottom line for water quality as water suitable for boating and wading. The national

government will provide 12 million NZD to regional councils over the next four years to achieve consistent bottom lines nationwide, and to completely implement the Policy Statement by the year 2025 (Ministry, 2014).

The main goals of the Policy Statement are to encourage community involvement in improving water management and quality, and to attain national bottom lines in every region. The requirements of the statement include strict record keeping of all water entering and exiting each *whaitua*², declared values of “ecosystem health” and “human health,” and prioritized protection of freshwater species. The regional councils must improve their local water quality and no council objective may be set lower than the established national bottom lines (Ministry, 2014).

2.4.2 Porirua Harbour and Catchment Strategy and Action Plan 2012

The Greater Wellington Regional Council, the Porirua and Wellington City Councils, the Ngati Toa Rangatira tribe and a number of other community organizations introduced the Porirua Harbour and Catchment Strategy and Action Plan in March of 2012. 15 local agencies have adopted this plan in order to better manage and protect Te Awarua-o-Porirua Harbour and its estuaries and catchments. The plan aims to work with the community to reduce the rates of sedimentation in the harbor by enforcing stricter land management regulations, strengthening inter-agency collaboration through effective leadership and communication, and restoring ecological health to the harbor by reducing pollutant inputs and following through with the steps outlined in the plan (PCC, 2012).

² In the context of this report a *whaitua* is an area of land encompassing a specific drainage basin.

2.5 Key Stakeholders

2.5.1 Greater Wellington Regional Council

The Greater Wellington Regional Council is the governing body overseeing the four major cities on the southeastern end of the North Island: Wellington, Lower Hutt, Porirua and Upper Hutt (GWRC, 2015). The council is responsible for taking strides to protect the environment and well-being of the community by developing emergency management plans, implementing natural resources protection, and by managing and monitoring regional parks, public transportation and pollution control. The council also oversees water supply to the region by treating and supplying the water for the area's largest reservoirs for local distribution.

2.5.2 Te-Awarua-o-Porirua Whaitua Committee

The Te-Awarua-o-Porirua Whaitua Committee is a subsidiary of the Greater Wellington Regional Council. The committee serves as a liaison between the communities in the designated whaitua and the Regional Council. Their objective is to improve local land and water quality through implementation of the National Policy Statement and to create a Whaitua Implementation Plan (WIP) detailing a plan of action to help communities with future land and water management issues. The Te-Awarua-o-Porirua Whaitua Committee consists of members from the National Resource Committee, local officials, and any resident in the whaitua with interest and knowledge related to water management (GWRC, 2015).

Te-Awarua-o-Porirua Whaitua Committee's plan is to spend more time in the field learning about and discussing the policies and regulations relevant to the issues, health monitoring resources, historical data, current hydrology and water use and local ecology and biology. The committee plans to spread awareness throughout the community and to get the

local residents involved in their plan of action. They currently hold regular meetings open to the public to discuss progress and request input. The committee is currently in “Phase 3” of their plan which involves declaring the scope of the project and recognizing the issues at hand, proposing possible solutions, and establishing the WIP which they aim to finish by February of 2016 (GWRC, 2015)

2.5.3 Porirua & Wellington City Councils

The Porirua and Wellington City Councils are governing bodies made of elected officials in their respective cities. They are a local authority but hold lower rank than the Greater Wellington Regional Council and national parliament. A city council is responsible for forming the city’s vision and implementing programs to better the economy, environment and the overall well-being of its residents. Currently the City of Wellington is focusing on increasing its global appeal and improving its services (WCC, 2015). While the City of Porirua is working towards upgrading its infrastructure and allocating funds towards a variety of programs including recycling and business development (PCC, 2014). The pollution in Te-Awarua-o-Porirua Harbour is a direct concern of the Porirua City Council but also indirectly involves the Wellington City Council as some Wellington City residents live within the harbor’s catchment boundaries (PCC, 2012).

2.5.4 Wellington Water, Ltd.

Wellington Water, created in September of 2014, is the new company that oversees the drinking water operations for the Greater Wellington Region. Formed by a merger of Capacity Infrastructure Services and the Greater Wellington Regional Council’s water supply and distribution company, it is jointly owned by the Greater Wellington Regional Council and the

Hutt and Upper Hutt, Porirua, and Wellington city councils. The company is currently working with whatua committees to develop consistent water monitoring methods and to meet the requirements of the National Policy Statement. Wellington Water is also focused on increasing community awareness and education on the water quality issues in the region (Wellington Water, 2015).

2.5.5 Porirua Harbour and Catchment Community Trust

In March of 2011, Porirua City Council, Greater Wellington Regional Council, Wellington City Council and the Ngati Toa Rangatira established The Porirua Harbour and Catchment Community Trust as a means to include the concern of both arms of Te-Awarua-o-Porirua Harbour in one active organization. The purpose of the trust is to promote sustainable management of the entire harbor and its estuaries and catchments. The trust works closely with the Porirua City Council but is an independent advocate for the harbor. The trust also aims to spread community awareness and increase education on both the ecological and environmental issues concerning the harbor, and contributes to other local groups seeking to revive and protect the harbor (Trust, 2013).

The trust publishes annual “scorecards” that measure progress in improving the harbor and the current status of pollution. Trust representatives on the review panel synthesize information from the Porirua and Wellington City Councils and from the trust’s own surveys and projects. The Trust releases yearly reports every February of the new year (Trust, 2013).

2.5.6 New Zealand Transport Agency

The New Zealand Transport Agency is a national organization that constructs and maintains state highway networks, issues licensing, registrations, and collects use charges for

these roads. The agency conducts national educational programs on highway safety and usage and administers community surveys to connect with and respond to the public. Regarding environmental concerns, the agency ensures that every construction project adheres to an environmental management plan. These plans aim to follow regulations set in place by the Resource Management Act and the Department of Conservation (NZTA, 2015).

In addition to the environmental management plans, the New Zealand Transport Agency works to protect the natural ecosystems its activity may intersect through environmental research, spill reduction, sediment and erosion control, and communication with its contractors. Since construction of state highway systems may cause habitat loss, harm to wildlife, and chemical contamination, the Transport Agency is taking measures to minimize their impact as much as possible (NZTA, 2015).

2.6 Social Impacts of Poor Water Quality

2.6.1 The Current Conflict over Water Quality Laws in Porirua

In August of 2015, the Greater Wellington Regional Council tightened water quality laws on the Greater Wellington Region in response to the National Policy Statement for Freshwater Management. In accordance with these laws, the Porirua City Council had to develop a strategy for meeting the new requirements. This resulted in the Porirua City Council passing a bylaw that banned all street car washing, which meant that the people of the Porirua area could no longer wash their cars in their driveways or in the streets. The reasoning given to the public behind this bylaw was that the excess detergent and car wax used in the act of washing a car was running into the storm drains without filtration. This meant that the contaminant-laden water was running

straight into the harbor and contributing to the overall pollution. However, while the council prohibited washing a car on the street or a driveway, washing a car on the grass or at a commercial car wash was still allowed as the grass and soil filter out the chemicals in the used water and commercial car washes connect directly to wastewater systems.

The people of the Porirua area are generally upset about the passing of this new bylaw. The majority of the people living in the Porirua area are low income families and for some residents, there are no lawns or commercial car washes for them to use, leaving them without any options. This led to general dissatisfaction, with people accusing the government of “banning a piece New Zealand culture” and vowing to defy the new bylaw by washing their cars regardless of location. However, even with the unrest caused by the passing of this bylaw, it has been partially successful by educating people as to what exactly they were washing into the harbor. An article on the subject states that “of the 80,000 people who lived in the harbor catchment area, 65 per cent were unaware that stormwater drains led directly into the harbor” (Hunt, 2015). Even if the people Porirua residents do not follow this new bylaw, they are now at least aware of what they are doing, and how they can reduce their contribution to the harbor’s pollution. However, due to the low socioeconomic standing of the major populace of Porirua, even the knowledge of the pollution does not seem to have any effect. While the general consensus is that people would like to see the harbor cleaned up, people are unwilling to divert their taxes into restoring the harbor when their priorities may lie elsewhere.

Since the enactment of the bylaw, the Porirua City Council has allowed a one year grace period, in which the people of Porirua could be further educated in the reasons behind the change. After the grace period, the city council is only using prosecution as a last resort, stating

that the “council is not banning washing cars. It's a ban on domestic contaminants being flushed into stormwater drains, which end up in the harbor” (Hunt, 2015).

2.6.2 The People of Porirua and the Pollution

While the Porirua City Council is taking measurements to reduce the city’s pollution of the harbor, many obstacles due to the low income nature of the city have surfaced. As stated in section 2.3.5, in April of 2015, the local recycling center “Trash Palace” shut down due to a cut of funding, driving the non-profit into bankruptcy. Run by the Mana Recovery Trust, the center employed many people with mental health issues that would not have been able to find employment anywhere else. However, after receiving a 20% budget cut from their financial assistance from the Capital & Coast District Health Board, the center was suddenly forced to close down, leaving many people finding themselves without jobs.

With the shutdown of “Trash Palace,” people now throw their inorganic trash into landfills, perpetuating the pollution of the harbor. The Porirua City Council is currently hopeful that “some sort of new community organization will emerge so Trash Palace is not lost forever” (Armstrong, 2015).

2.6.3 The Effect of Pollution on the Maori Way of Life

The pollution of the Te Awarua-o-Porirua Harbour affects more than just the people living in the immediate area. Further down the river, the Ngāti Toa tribe has lost their ancestral fishing grounds to the urbanization of the city. For years, the tribe had fished in the river, taking only what they needed from the rich ecosystem, consisting of “kaimoana: cod, snapper, kahawai, flounder, mullet – around 30 species of fish in all – plus piles of mussels, cockles, bubus and pipis” (Mcgregor, 2010). With the current pollution levels of the harbor that ecosystem is dying,

leaving the tribe with nothing. This change to the ecosystem did not come quickly; the destruction of land took place over the past century. The construction of buildings such as the Porirua Lunatic Asylum, which by the 1950s was pumping thousands of gallons of effluent and contaminants a day into the river, expedited the pollution. At the time, the Ngāti Toa tribe was unaware of the dangers that the construction spread into their water so they continued to fish, which resulted in cases of typhoid among the tribe. Today, while the tribe and city of Porirua are now working together, the harbor has become unfishable with grim prospects of returning it back to its cleaner state.

2.6.4 The Effect of Pollution on Tourism

The loss of the ecosystem surrounding Te Awarua-o-Porirua Harbour not only impacts the local Maori way of life, but also greatly impacts the tourism scene of Porirua. Porirua is home to many eco-tourism sights, such as the Pauatahanui Wildlife Reserve, a wetland reserve, home to many different species of waterfowl and fish. With the sedimentation from the excess construction and urbanization of the area, as well as the contamination caused by the runoff of things such as sewage, rubbish and chemicals used in car washing, the fragile ecosystem of the reserve is under threat of destruction. While the reserve is somewhat protected by the ring of roads separating it from the majority of the pollution, the development of the housing and roads around it have drastically changed the ecological and hydrological condition of the inlet. The preservation of this reserve is imperative not only for the continuation of the tourism industry, but also for the animals living in the reserve.

In addition to this destruction, local businesses have also been negatively affected due to the pollution. The harbor, which attracts many boaters each year, has become dangerous to traverse with the buildup of sediment creating artificial shallows that are hard to see. This results

in many of the boaters having to weave their way through the harbor just to reach the designated sailing course.

2.7 Water Treatment

Approximately two-thirds of potable water comes from surface sources such as rivers, lakes, and dams while the remaining third comes from underground aquifers (EPA, 2015). Since each water source has unique properties, engineers use different treatment methods to ensure quality. Before water treatment begins, the treatment facility conducts an assessment of the water source determining its viability and how heavily a treatment plant can draw from it. For example, if a river is a water source, experts would determine a limit on how much water the facility can draw so as not to adversely affect flora and fauna that utilize the river (D. Gaze, personal communication, November 3, 2015).

2.7.1 Methods of Water Treatment

The United States Environmental Protection Agency (EPA) lists several methods of water treatment: Flocculation/Sedimentation, Filtration, Ion Exchange, Absorption, and Disinfection. Flocculation/Sedimentation is the process of adding coagulants to source water so that contaminants too small for filtration can clump together into more manageable sizes. Filtration is the straining of source water to physically separate contaminants. Ion exchange is the filtering out of inorganic and chemical contaminants such as arsenic, chromium, excess fluoride, nitrates, radium, and uranium by passing a current through the water and separating out the various ions dissolved in it. Absorption is the process where water runs through a carbon powder. As it passes through, taste and odor generating contaminants attach to

the carbon and separate out of the water. Lastly, disinfection is the process of adding chemicals such as chlorine, chloramines, or chlorine oxide to the water to kill harmful microorganisms, though using UV light achieves the same effect. (EPA, 2015).

In the case of harbor water treatment, experts recommend either limiting pollution at the source, or removing and containing contaminants that the harbor cannot naturally sweep out to sea. To limit pollution at the source, workers set up end-of-line water treatment facilities. Barriers are set up to prevent debris and other pollutants from entering the harbor via storm drains (UDT, 2015). Should these efforts fail, or if contaminants have sunk to the sea floor, other methods are then used to clean the harbor. These other methods include dredging sediments, capping sediments, enhanced monitored natural recovery (EMNR), and monitored natural recovery (MNR). Dredging involves the physical removal of contaminated sediments and there are two main types, mechanical and hydraulic. Mechanical dredging is when workers use buckets to scoop sediment up, and hydraulic dredging is when workers pump water through a large pipe, creating suction which draws the sediment up through it. Capping is the placement of clean material such as sand over contaminated sediments. This method isolates the contaminants from people and wildlife. Plant life can even cover the caps creating new habitats for marine life. EMNR is a similar method to capping where workers place a thin layer of clean material such as sand over the contaminated sediment. While not as permanent as capping, EMNR slows the spread of sediment contamination and is often used to reduce the time needed for other methods to take effect. MNR is suitable in areas where low levels of contamination exist over a large area and other methods are not feasible. Essentially it is the monitoring of the aquatic system and ensuring that cleanup occurs through natural processes such as: degradation by microorganisms, conversion to less toxic forms of chemicals, burial by natural sedimentation

and dispersion. Lastly, treatment is the use of physical or chemical processes to remove pollutants or to convert them to less toxic forms. However, this usually requires the contaminated material to be first removed from the water source via dredging (LWG, 2015).

2.7.2 Implementation of Water Treatment

Due to the specialized nature of these methods and the unique characteristics of each water source, water treatment engineers choose a combination of methods for each source, optimized to ensure water quality (Watercare, 2015). The standards for water quality also differ depending on whether the city intends to use the water for recreational or drinking purposes. Water for recreational use may have a lower standard of quality than water intended for human consumption, and these factors also influence the choice in treatment measures (D. Gaze, personal communication, November 3, 2015).

2.7.3 Low Impact Development

The United States Environmental Protection Agency defines Low Impact Development (LID) as practices that manage stormwater by minimizing impervious cover and use natural or man-made systems to filter and return stormwater into the ground (EPA, 2009). The goal of LID is to reduce runoff and mimic a site's predevelopment hydrology. This is accomplished by minimizing impervious cover and treating stormwater runoff close to its source, rather than treating the water in costly end-of-pipe facilities (UDT, 2015). LID practices shown in Figure 4 include preserving pervious space and utilizing rain gardens, green roofs, porous pavement, and biofiltration. Implementation of LID decreases pollution caused by stormwater runoff and can also reduce risk of flooding during heavy rainfall. Despite all of these benefits, one of the primary concerns about the implementation of LID is the issue of cost, with a common

misconception that they are prohibitively expensive. However, the EPA conducted a study in 2009 of 17 development projects in the United States using LID and compared the cost of the LID implementation to the estimated cost of conventional development. Of the 17 projects in the survey only one showed an increase in overall cost with the other 16 demonstrating a 15-40% drop (EPA, 2009), thus demonstrating the feasibility of LIDs.

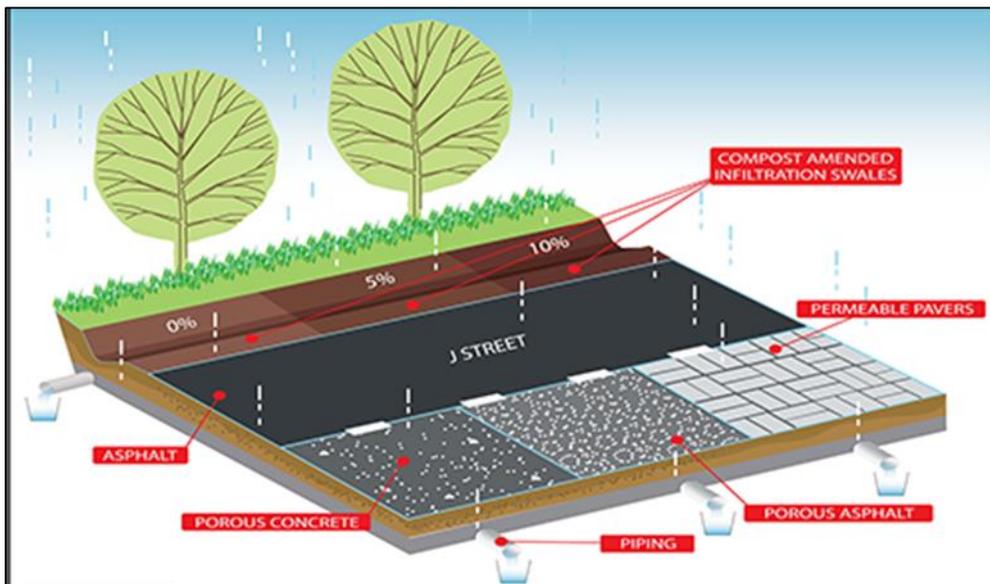


Figure 4. Examples of Low Impact Development (YCW)

3. Methodology

This project aids the Greater Wellington Regional Council in developing a potential low impact, cost effective water treatment method to restore polluted Te Awarua-o Porirua Harbour to a state that is once again safe for recreational activity. We will achieve our project goal by accomplishing the following objectives: (1) Gaining an on-the-ground perspective of the harbor's pollution status and background on prior management solutions, (2) Analyzing water management officials' perspectives on the causes of pollution and potential solutions for the situation through interviews, (3) Assessing community awareness and opinions of the issues regarding pollution in the harbor through public surveys, (4) Performing a feasibility analysis of possible solutions for the pollution issue, and (5) Providing recommendations for a practical water treatment or pollution prevention method that benefits the entire community.

As there is controversy around the management of the harbor, we anticipate that our project objectives may raise some sensitive topics with interviewees. The biggest and most probable issue that this project may confront is disagreements between private contractors and Wellington or Porirua City authorities. For instance, the contractors may provide solution options that they feel are the most effective in limiting pollution, whereas the city authorities may favor an option that comes at a low cost with minimal impact on the environment and the population. This conflict between the two groups outlines the issue of developing an affordable, low impact, and effective solution to the harbor's pollution. Another conflict that we are anticipating is that cleaning the harbor may not be high on the priority list of Porirua City residents. The residents may agree with the idea of cleaning the harbor, but they might want their tax dollars going towards public services that provide more immediate benefit. In an initial phone conversation with a representative of the Greater Wellington Regional Council, the project

team learned that Porirua is low on the New Zealand socioeconomic ladder. We will take this information into consideration for every step of the project when determining solutions.

3.1 Understanding the Pollution Issue

3.1.1 A Visual Understanding of Harbor Issues

Before talking to stakeholders and finding suitable pollution reduction technologies, we need to first observe Te Awarua-o-Porirua Harbour to gain a better perspective on the current state of pollution. This entails visiting the harbor and examining visual signs of pollution or circumstances that may create problems under specific conditions such as flooding. It also allows us to gain a familiarity with the spatiality of the harbor area, which is valuable when developing recommendations for the Greater Wellington Regional Council. It is going to be ideal to have our sponsor or an expert on the harbor show us around the area and walk us through the steps already taken to improve the water quality in the harbor over the past several years.

We may also learn key information from an informal interview with our sponsor once the team arrives onsite. Our sponsor liaison at the Greater Wellington Regional Council has an idea of the path that our project should take. Our team has already considered the majority of these ideas through other means of communication, but the most helpful information will come from in-person communication. This initial contact, along with our first glimpse of the polluted harbor will provide a much better sense of what we will accomplish during our time in Wellington.

3.1.2 Determining Stakeholder Influence and Importance

This project includes analyzing the opinions of several stakeholders and outside sources. In our first initial onsite research we will work with our sponsor to determine which stakeholders are going to have the most knowledge on the present issues and which stakeholders would have the greatest influence on implementing change in the harbor. We will assess the impact and priority of the project for each stakeholder using the graphic shown in Figure 5. The most influential opinions will come from stakeholders placed in the "Key Player" quadrant of the figure. Our team will still consider voices within the "Least Important" section in our research, but to a lesser extent. Based on our background research we are already able to make educated assumptions of where each stakeholder will fit on this graph. We will categorize the stakeholders in the following sections regarding the assessment and evaluation of all contributors.

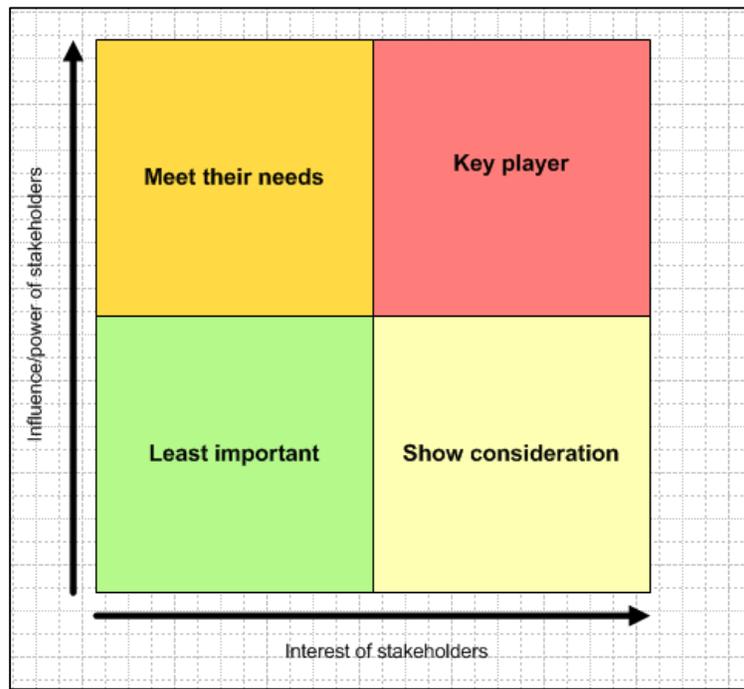


Figure 5. Interest versus Influence Graphic (Stakeholder, 2015).

3.2 Interviewing Key Stakeholders and Assessing Community Awareness

When interviewing the key stakeholders in Te Awarua-o-Porirua Harbour, our team needs to separate data according to the interest versus influence graphic shown in Figure 5. Every contributor's opinion has value but some will have a greater influence on our project, based on their political power and community engagement. In order to get the most information from key stakeholders, we will be conducting in-depth interviews of a small sample size and quick surveys of a larger sample size. Interviews will consist of open-ended questions and will require coding in order to classify responses. Surveys will consist of multiple choice questions that our team can give to residents and visitors over a brief period of time. The use of multiple choice questions will allow us to reach a larger sample size easier and simplify the analysis of survey responses.

3.2.1 Unaffiliated Professionals in the Water Treatment Industry

An important part of the project will be the opinions and ideas from people who work daily with various water treatment methods. All experiences are helpful, but we will aim to speak with people who may specifically contribute to restoring the harbor to a state that is safe for recreational use and wildlife conservation. More specifically, we will be targeting groups such as water treatment professionals and environmentalists. It will be important to first interview engineers associated with the current pollution issue. These engineers may have ideas for pragmatic solutions for treating the harbor. The information we are seeking from these professionals are which low impact designs they think will improve the quality of Te Awarua-o-Porirua Harbour, the costs of such designs, the length of time it will take to construct these technologies, and the impact on the society and the environment over a long term period.

Another important influence within this group would be environmentalists without association to the Wellington or Porirua City Councils. These unaffiliated voices will be able to identify the issues and help provide low impact solutions with little to no political bias. Information that we hope to gain through interviews include the causes of pollution in the harbor with the highest impact, technologies the environmentalists have seen or used to address such pollutants, and how these technologies may affect the environment and society over a long term period.

Additional groups of unaffiliated professionals that may hold key information are land developers and construction companies. In the past, these businesses contributed to the pollution of the harbor due to relocation of foreign sediments. It will be important to understand the strategies that these companies are currently implementing, or plan to implement, that will reduce the pollution caused by their work from happening in the future.

Our team will conduct all of these interviews (Appendix A) based on a scheduled time slot determined well in advance. We will interview companies that have had previous connection with Te Awarua-o-Porirua Harbour or any of the local government groups. Our sponsor at the Greater Wellington Regional Council will facilitate our contact with potential interviewees. The interviews will be either in person or over the phone based on the convenience of the interviewee. The information we gain from the private sector will be helpful when determining feasible solutions. We can categorize all unaffiliated professional's interviews within the "shows consideration" section of Figure 5.

3.2.2 Government Officials

A key group that has an important influence on this project are the government officials consisting of city politicians, employees and programs. The general question that we will be

assessing is the interest level within these groups of impactful leaders. Some of the most important stances within the public sector will be from the Porirua City Council and the Greater Wellington Regional Council. These two groups may have conflicting opinions in solving the pollution problem within Te Awarua-o-Porirua Harbour. We intend to set up in-depth interviews (Appendix B) with as many city planners and government groups involved with the harbor to determine opinions on specific issues involved in minimizing pollution and potential plans they are considering executing. The specific issues include determining the most impactful sources of pollution, how important it is to clean the harbor, how much money the council intends to dedicate to pollution prevention technologies and the source of this funding. We will also determine from the interviews the interest level of reducing harbor pollution within each council and group. All of these groups will have a high influence, but determining the interest level of each will allow us to categorize each group as either a “key player” or “meets their needs” in accordance with Figure 5.

An important government-funded stakeholder also involved in this project will include the New Zealand Transport Agency. They are a speculated cause of pollution to the harbor and will also have an impact based on how they continue to operate their business. We will ask them the same interview questions as the city planners, and the agency has established that they have a high concern about their contributions to the environment, so we can categorize them as a “key player” according to Figure 5.

A local government agency that falls between “least important” and “shows consideration” in Figure 5 would be the local law enforcement. We wish to speak with officers of law enforcement since they are the ones who witness and penalize those who illegally dump in the harbor and add to the pollution. Our team will survey officers with the questions that we

specified for the community, but we will additionally ask how often they witness and penalize for these crimes. Our team can also give one representative of law enforcement a formal in-depth interview created for city planners and government groups.

Since the public sector includes the highest impact and importance stakeholders, we aim to get the most information from them. We will plan several interviews for these groups and will also give them the same survey given to the rest of the community.

3.2.3 Community Groups and General Public

Solving Te Awarua-o-Porirua Harbour's pollution problem will possibly have the most effect on the general public of Porirua and Wellington, making them an important stakeholder. Their opinions will be of high importance, however, it will have a low impact on final decisions that the government makes to reduce harbor pollution. An opinion of several individuals will have a high impact, as well as the leaders of community groups organized by the public. The best technique for gathering their opinions is to conduct a survey of the general public. The survey (Appendix D) will be brief and ask questions such as how often the surveyed person uses the harbor, how important cleaning the harbor is to them, how inconvenient certain preventative policies have been (for example the car wash ban), how much of their tax money should be going towards a pollution solution, and how involved they want to be in the continuation of this project. All surveys will be anonymous with the option to stay informed of our group's progress. We will conduct our surveys in different public areas of the Greater Wellington Region within Figure 6 as well as online if our sponsor is able to provide a way to distribute it.

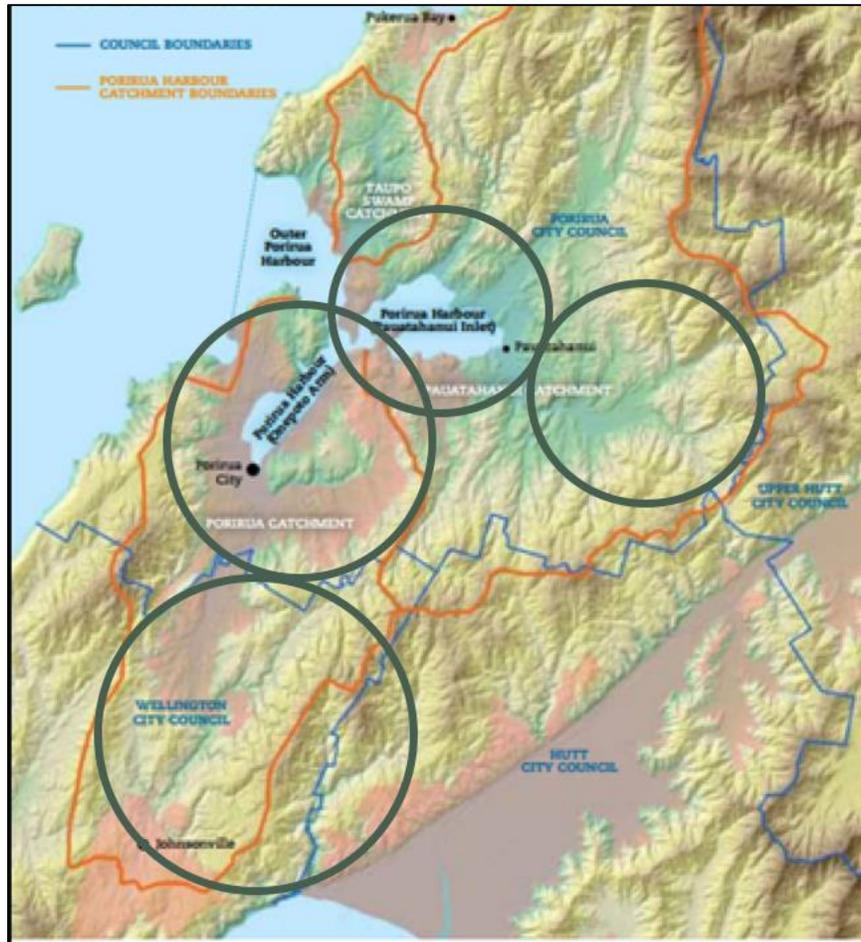


Figure 6. Regions around the harbor and upstream where we will survey (PCC, 2012)

In addition to this survey, we will create in-depth interviews (Appendix C) with similar questions modified to be open-ended. We will facilitate these interviews with willing political leaders, members of community groups, and non-profit environmental groups. We want as many opinions as possible to contribute towards our project in order to find the best solution for restoring the water quality of Te Awarua-o-Porirua Harbour to the recreational and tourist attraction it once was.

3.3 Feasibility Analysis of Pollution Abatement Strategies

Our team will conduct a feasibility analysis for our project in order to find and recommend the best technologies that the Greater Wellington Regional Council can implement in the harbor. We first need to code and organize the interview responses and analyze the survey results from stakeholders with spreadsheet documentation in order to find information such as the costs of the treatment technologies, the budget that the city is working with, and the overall interest in the restoration of the harbor. We can then use this information to assess the feasibility of different water treatment technologies. When analyzing constraints such as the cost of the water treatment methods, we must take into account the socioeconomic standing of Porirua. It is not a high income city like Wellington, and as such, the budget for the harbor restoration might be extremely limited. The final step will be a balance of comparisons between technologies and their impacts, along with the costs of these technologies and what the community is willing to fund (based on information collected in the interviews and surveys). Additional constraints that our team will need to consider other than cost feasibility will be the impact of the technology on the environment, the institutional fit with managers, and consistency with community needs and interests. This overall feasibility study will help us narrow down the options Porirua City has for reducing the pollution in its harbor and will allow us to make insightful recommendations of technologies they could use.

3.3.1 Organization of Budget

When analyzing the organization of the budget for the project, we will search for any preexisting city capital improvement plans as well as any asset management plans if available. These will be extremely useful in determining the previous work that the Porirua City Council

has put towards the restoration of Te Awarua-o-Porirua Harbour. By seeing how much money has been set aside by the city for the improvements of the harbor, we can roughly gauge the priority level the city and the people of Porirua are currently placing on its restoration. Our team can then gauge the tax dollars from the citizens of Porirua going into the restoration of the harbor.

When looking at the budget for Porirua, we also need to take into account how other cities have gone about protecting their water from pollution and evaluate whether or not the same solutions that they implemented would apply to Porirua in terms of sources of pollution as well as anticipated costs.

3.3.2 Replacing vs. Repairing

When determining solutions to the pollution problem that Porirua City is facing, one of the biggest factors that we need to include in our assessment is money. Because of this, we need to find the most cost effective solution. We will need to look at factors such as the initial cost of the solution, the cost of maintenance, and calculate the long-term savings of each solution. Thus, we can determine the cost of replacing versus repairing. In some cases, while repairing something can be quick and cheap, the cost of having to fix it over and over again eventually accumulates and in some cases might end up costing more than just completely replacing it. We will gather the information needed to perform this analysis through our interviews with unaffiliated professionals or through additional research into the specific technologies we will be assessing.

3.3.3 The Environmental Impact Constraint

Another factor to consider is the environmental impacts of the different potential solutions. In proposing potential solutions we want to be as environmentally friendly as possible and avoid methods that may inadvertently have negative environmental consequences. Since limiting potential solutions to those that are most environmentally friendly may increase the estimated cost, it will be important to assess the relative importance of the environment to our stakeholders. Our surveys of the community and interviews with professionals will tell us how heavily to weigh environmental concerns.

3.3.4 The Institutional Fit with Management Interests

When determining solutions, our team has to take into account the interests of the governing body as well. They are the ones that will be paying for the restoration itself therefore our solutions should meet their criteria. These criteria can vary from things such as solutions having to clean the harbor within a set amount of time, or having to have a reduced impact on the environment. Our team will gather this information through our interviews with government officials as well as government affiliated engineers.

3.3.5 Consistency with Community Needs and Interests

The community of Porirua will be the group that is most affected by the harbor cleanup. As such, it is necessary for our team to assess their interests as well. We will gather this data through surveys conducted around the harbor area as well as ones conducted further inland. In an ideal situation, the solution chosen by the Greater Wellington Regional Council will satisfy both the government's interests as well as the community's interest. However, as shown by the backlash caused by the passing of the car washing bylaw, that is not always the case. We will need to find solutions that both stakeholder groups can agree with because without the cooperation of the other, the conflict can hinder the restoration of the harbor, if not halt it altogether.

Summary

Providing solution recommendations for the pollution issue in Te Awarua-o-Porirua Harbour requires the collaborative efforts of several influential stakeholders including the Greater Wellington Regional Council and the Porirua and Wellington City Councils. Our team's main task is to determine, through interviews and surveys, the opinions and ideas of these stakeholders pertaining to restoring the health of the harbor. We will then conduct a feasibility analysis to determine if stakeholder recommendations are practical for the situation in Porirua City. Finally, based on our feasibility assessment of local and stakeholder opinions, we will provide recommendations to the Greater Wellington Regional Council for ways to mitigate the pollution in Te Awarua-o-Porirua Harbour.

Appendix A: Interview of Unaffiliated Professionals

Te Awarua-o-Porirua Harbour:

Assessing Community Awareness and Analyzing Methods to Reverse Pollution

Interview for Key Stakeholders: Unaffiliated Professionals

Date/Time:

Location:

Interviewer:

Interviewee:

Secretary:

Job Position:

Acknowledgement and Confidentiality Notice:

Thank you for participating in our interview. My name is _____ and I represent the group of students from Worcester Polytechnic Institute in the United States that are working with the pollution issues in Te Awarua-o-Porirua Harbour. Our research consists of identifying the pollution sources that exists in and around the harbor. Our main objective is to identify the different stances of each stakeholder in how to resolve the issues in the harbor and to determine a low impact, cost effective solution that is suitable for Porirua City and its community. Your input in the following interview will provide very important information that we can use to accomplish this goal. The interview may last anywhere between one half hour and one hour. The information you provide including answers and demographic information will remain anonymous unless otherwise noted. Once again we thank you for taking the time to speak with us.

Interview Questions:

- 1) How familiar are you with the problem of pollution in Te Awarua-o-Porirua Harbour?
- 2) What is the most common form of water waste pollution you've encountered?
 - a) community involvement in the pollution

- 3) What types of technologies have you used to treat polluted water?
 - a) Specify High and Low impact designs
 - b) Do these treatments make the water consumable or swimmable?
- 4) What costs are there to consider when implementing water treatment technologies?
- 5) How long do implementations of such technologies take?
- 6) How might these technologies be rejected/argued against by city planners? Why?
- 7) How might the community respond to these technologies? Why?
- 8) How do you feel about the success of past technologies that you have seen implemented?
- 9) Are there any long term effects to consider with these technologies?

Additional Topics

- | | |
|--|-----|
| Would you like to be informed with our project progress? | Y/N |
| If needed, may we follow up with you after this interview? | Y/N |
| Do you wish to be recognized/ thanked in our final report? | Y/N |

(By default you will remain anonymous)

Space for Additional Notes:

Again we thank you for your time participating in our research. Your input will guide us towards what we hope to be very successful results in restoring Te Awarua-o-Porirua Harbour!

Appendix B: Interview of Government Officials

Te Awarua-o-Porirua Harbour:

Assessing Community Awareness and Analyzing Methods to Reverse Pollution

Interview for Key Stakeholders: Government Officials

Date/Time:

Location:

Interviewer:

Interviewee:

Secretary:

Job Position:

Acknowledgement and Confidentiality Notice:

Thank you for participating in our interview. My name is _____ and I represent the group of students from Worcester Polytechnic Institute in the United States that are working with the pollution issues in Te Awarua-o-Porirua Harbour. Our research consists of identifying the pollution sources that exists in and around the harbor. Our main objective is to identify the different stances of each stakeholder in how to resolve the issues in the harbor and to determine a low impact, cost effective solution that is suitable for Porirua City and its community. Your input in the following interview will provide very important information that we can use to accomplish this goal. The interview may last anywhere between one half hour and one hour. The information you provide including answers and demographic information will remain anonymous unless otherwise noted. Once again we thank you for taking the time to speak with us.

Interview Questions:

- 1) Are you aware of the pollution issues in Te Awarua-o-Porirua Harbour?
- 2) What is the most common form of pollution you've encountered?
 - a) community involvement in the pollution

- 3) What types of technologies have you used to treat polluted water?
 - a) Specify High and Low impact designs
 - b) For what purpose (drinking/recreation etc.)
- 4) What costs are there to consider when implementing water treatment technologies?
- 5) How long do implementations of such technologies take?
- 6) How might these technologies be rejected/argued against by city planners? Why?
- 7) How might the community respond to these technologies? Why?
- 8) How do you feel about the success of past technologies that you have seen implemented?
- 9) Are there any long term effects to consider with these technologies?

Additional Topics

Would you like to be informed with our project progress? Y/N

If needed, may we follow up with you after this interview? Y/N

Do you wish to be recognized/ thanked in our final report? Y/N

(By default you will remain anonymous)

Space for Additional Notes:

Again we thank you for your time participating in our research. Your input will guide us towards what we hope to be very successful results in restoring Te Awarua-o-Porirua Harbour!

Appendix C: Interview of Community

Te Awarua-o-Porirua Harbour:

Assessing Community Awareness and Analyzing Methods to Reverse Pollution

Interview for Key Stakeholders: Community

Date/Time:

Location:

Interviewer:

Interviewee:

Secretary:

Job Position:

Acknowledgement and Confidentiality Notice:

Thank you for participating in our interview. My name is _____ and I represent the group of students from Worcester Polytechnic Institute in the United States that are working with the pollution issues in Te Awarua-o-Porirua Harbour. Our research consists of identifying the pollution sources that exists in and around the harbor. Our main objective is to identify the different stances of each stakeholder in how to resolve the issues in the harbor and to determine a low impact, cost effective solution that is suitable for Porirua City and its community. Your input in the following interview will provide very important information that we can use to accomplish this goal. The interview may last anywhere between one half hour and one hour. The information you provide including answers and demographic information will remain anonymous unless otherwise noted. Once again we thank you for taking the time to speak with us.

Interview Questions:

- 1) How often do you use the harbor?
- 2) How important is cleaning the harbor to you?

- 3) How inconvenient have certain preventative policies been (for example the car wash ban)?
- 4) How much of your tax money would you be okay with going towards a pollution solution?
- 5) How involved would you like to be in the continuation of this project?

Additional Topics

- | | |
|--|-----|
| Would you like to be informed with our project progress? | Y/N |
| May we follow up with you after this interview if needed? | Y/N |
| Do you wish to be recognized/ thanked in our final report? | Y/N |

(By default you will remain anonymous)

Space for Additional Notes:

Again we thank you for your time participating in our research. Your input will guide us towards what we hope to be very successful results in restoring Te Awarua-o-Porirua Harbour!

Appendix D: Survey of Community

Te Awarua-o-Porirua Harbour:

Assessing Community Awareness and Analyzing Methods to Reverse Pollution Survey for Community

Date/Time:

Location:

Interviewer:

Acknowledgement and Confidentiality Notice:

Thank you for participating in our interview. My name is _____ and I represent the group of students from Worcester Polytechnic Institute in the United States that are working with the pollution issues in Te Awarua-o-Porirua Harbour. Our research consists of identifying the pollution sources that exists in and around the harbor. Our main objective is to identify the different stances of each stakeholder in how to resolve the issues in the harbor and to determine a low impact, cost effective solution that is suitable for Porirua City and its community. Your input in the following interview will provide very important information that we can use to accomplish this goal. The interview may last anywhere between one half hour and one hour. The information you provide including answers and demographic information will remain anonymous unless otherwise noted. Once again we thank you for taking the time to speak with us.

Survey Questions:

1) Sex: Male Female

2) Nationality: Pakeha Maori Other: _____ Unspecified

3) Age Group: 0-12 13-1718-2122-3536-5051-6565+ Unspecified

4) How often do you use the harbor?
Never Rarely Somewhat-Often Often Always

5) How important is cleaning the harbor to you?
Not Important Somewhat-Important Neutral Important
Very Important

6) How have certain preventative policies worked out (for example the car wash ban)?
Very Inconvenient Somewhat-Inconvenient Neutral Somewhat-Convenient Very Convenient

7) How much of your tax money would you be okay with going towards a pollution solution?
None Some However Much Needed Other: _____

8) How involved do you want to be in the continuation of this project?
Yes No Other: _____

Additional Topics

Would you like to be informed with our project progress? Y/N

May we follow up with you after this interview if needed? Y/N

Do you wish to be recognized/ thanked in our final report? Y/N
(By default you will remain anonymous)

Space for Additional Notes:

Again we thank you for your time participating in our research. Your input will guide us towards what we hope to be very successful results in restoring Te Awarua-o-Porirua Harbour!

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Figure 4. Examples of Low Impact Development. Retrieved December 14, 2015 from <http://www.yakimacounty.us/689/Demonstration-Project>

Figure 5. Interest versus Influence Graphic. Retrieved December 13, 2015, from <http://stakeholdermap.com/images/stakeholder-analysis.gif>