

Memorandum

Catie Willett

The paper and pulp industry is one of the oldest industries in the world, dating back to the late 1600s.¹ Although this industry supports one of the most popularly consumed products, few understand the process that is required to create just one piece of paper. The process is quite toxic for the environment, as the pulp making process—the initial treatment done to bark to create paper—requires thousands of gallons of fresh water along with large quantities of lumber mixed with large amounts of chlorine and other chlorinated compounds. As such, this industry requires copious amounts of regulation since the process can be dangerous if improperly managed. However, even as one of the most regulated industries, there are still negative environmental effects from the waste water produced by this industry.

To fully understand the effects of the paper industry on the environment and the policy surrounding its operation, this memo will articulate the primary problems associated with the paper industry, policies in place to assist in reducing these problems their corresponding attributes, and finally recommendations that could be implemented to improve current policy programs in place.

Problem Summary

When creating paper, the first step is to create pulp. There are multiple methods to create pulp, but one of the most common ways is through the Kraft pulping process.² This process requires gallons of fresh water and copious amounts of lumber. The two are mixed together along with sodium hydroxide and sodium sulfide at high temperatures to separate the cellulose fibers of the wood to create a soft, brown pigment, which is pulp.² This substance is then bleached white using variations of chlorine before entering a machine that compresses the pulp into a flat shape, draining the chemically filled water from the pulp and allowing the substance to dry.² After the water is drained from the pulp, it becomes contaminated waste water.

To treat the contamination, the waste water goes through two required treatment systems, primary and secondary treatment, and is then filtered back into freshwater systems.³ However, these treatment systems are not catching all the harmful chemicals used in the pulping process, as certain chemicals are much more expensive to clean out than others and some sediments are too small for large treatment systems to catch. As a result, excessive amounts of BOD, SS, and chemicals are entering fresh water systems causing serious alterations to aquatic species and potentially harming nearby communities.³

One of the most troubling chlorine compounds produced from the pulping process is chlorine dioxide, a reactive chemical, particularly when exposed to water.⁴ It is also one of the most common chemicals found in contaminated pulping water, even after the treatment process. When chlorine dioxide enters freshwater systems, its toxicity strips the skin off fish, manipulates their bodies to become engorged, interrupts their development process, damages the immune system, interfere with hormones, and, in worse case scenarios, cause cancer to those who eat the fish exposed to this chemical.⁴

¹ “History of AF&PA and Our Industry,” *American Forest & Paper Association*, <http://www.afandpa.org/our-industry/history-of-af-pa-and-our-industry>, (2014).

² “How We Make Kraft Pulp,” *Catalyst Paper Corporation*, <http://www.catalystpaper.com/products/how/pulp>

³ Katherine E. Liney, Josephine A. Hagger, Charles R. Tyler, Michael H. Depledge, Tamara S. Galloway, and Susan Jobling, “Health Effects in Fish of Long-Term Exposure to Effluents from Wastewater Treatment Works,” *Environmental Health Perspectives*, 2005, 81-89, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1874182/>

⁴ “Dioxins,” *National Institute of Environmental Health Sciences*, <https://www.niehs.nih.gov/health/topics/agents/dioxins/index.cfm>

For example, one of the effects of contaminated wastewater is reproductive disorders in fish, specifically Roach.³ Male Roach are switching genders midway through their life cycles, in addition to suffering from additional alterations to their kidney development, cell count, and damage to their gills in the form of single-strange breaks.³ This species is commonly fished in America, as they can be found throughout the entire country and typically have a high reproductive rate, so they can be fished with minimal concern of overfishing.³ However, with reproductive changes in the fish, their reproduction rates will begin to dramatically decline. When rates decline, the fish become regulated to prevent fishing of the species, which would dramatically effect fisheries and communities who rely on this fish for food. Furthermore, this species' well-being tells a great deal about a waterbodies quality, as the Roach fish is usually the *last* fish to disappear as a result of water pollution.⁵ As their species begins to morph, this serves as a warning sign that the pollution entering the water as a result of paper production is dramatically harming aquatic ecosystems and will soon cause the extinction of fish, including the Roach fish, in certain waterbodies.

As a result of an industrialized, chemically focused pulping process, general waste water treatment processes for the industry are required. However, these treatment processes are not thorough enough to protect ecosystems and humans from the contaminated waste water, as dioxin continues to seep into freshwater systems. Thus, "treated" waste water is damaging marine life and increasing the risk of harm and disease for communities who consume these fish. The effects of this pollution are real and fast acting as, today, dioxin contamination has been traced in 85 sites around the U.S. and two fish consumption advisories have ensued because of excess dioxide.⁶ Since the paper industry is unlikely to reduce its production, as the demand for paper products remains high, and the process of Kraft pulping has existed firmly in paper mills since the 1800s with minimal alterations, the primary problem that needs to be addressed is the inadequate waste water treatment processes required for the industry.⁷

Policy Program Summary

Policy History

Primary and secondary waste water treatment are the only types of treatment legally required for the paper and pulp industry. These systems are an extension of the Clean Water Act, a law which, in short, makes it illegal to discharge pollutants from a point-source into U.S. waters unless a permit is obtained.⁷ The EPA oversees the enforcement of the CWA; however, the EPA gives many states the ability to spearhead and uphold their environmental regulations that coincide with the CWA in tandem with the EPA. In Virginia, for example, the Virginia Water Control Board and the EPA oversee environmental programs in VA in order to enforce specific permits called Virginia Pollutant Discharge Elimination System Permit (VPDES) regulations.⁷

The primary aspect of the VPDES permit that must be upheld is the EPA's Permit Guidance Document.⁸ This document establishes clear treatment guidelines for all U.S. paper and pulp industries in regards to their point-source pollution discharge. This document came about in 1998.⁸ Using the Multiple Stream Approach (MSA), one can clearly understand how this document came to fruition. MSA is made up of three different

⁵ Valtonen ET, Holmes JC, Aronen J, Rautalahti I, "Parasite communities as indicators of recovery from pollution: parasites of roach (*Rutilus rutilus*) and perch (*Perca fuviatilis*) in central Finland," *Parasitology*, 2003, Abstract, <https://www.ncbi.nlm.nih.gov/pubmed/14667171>

⁶ Institute of Medicine (US) Committee on Evaluation of the Safety of Fishery Products; Ahmed FE, editor, *Seafood Safety*. Washington (DC): National Academies Press (US); 1991, <https://www.ncbi.nlm.nih.gov/books/NBK235723/>

⁷ The Virginia Water Environment Association Government Affairs Committee, "Understanding Wastewater Regulation in Virginia," *Virginia Municipal League*, http://c.ymcdn.com/sites/www.vwea.org/resource/resmgr/Wastewater_Resources/Elected_Official_Handbook.pdf

aspects: the problem, the situation at hand which requires government intervention, policies, ideas that may develop into official policy, and politics, aspects that influence the way policy is viewed by the community.⁸

Planning for the EPA's Permit Guidance Document began in 1982, however, what sparked the document's necessity was a court case that took place in 1975 called *Train v. NRDC, Inc.*, 421 U.S.⁹ Ironically, this court case did not stem from a concern over water quality, but over concern for air quality. Five years prior to the court case, the Clean Air Amendment of 1970 was passed, which stated that the EPA is required to set "ambient air" quality standards to protect public health.⁹ What was considered "ambient air quality standards" was not explicitly articulated at the time, precise numbers for the amount of emissions were not yet set in place, although a concrete deadline to reduce emissions was.⁹ Nevertheless, states would develop their own standards and necessary implementation efforts, then submit them to the EPA for approval.⁹ The EPA has the authority to change aspects of the standards plan to meet specific deadlines and goals and disapprove of plans that do not fully abide by CAA guidelines.⁹

Train v. NRDC was brought to the U.S. Supreme Court because the EPA was sued by numerous environmental non-profit groups for not disapproving the state of Georgia's standards plan, as their implementation plan was not specific enough about certain details and they had an illegitimate timeline.⁹ The Supreme Court ruled in favor of the non-profit groups and stated that the EPA must disapprove of the plan precisely because their plan was ambiguous and details were omitted. When the EPA did not disapprove of this plan, it illustrated how there was no uniformity in standards for all states and their necessary pollution reduction rates.⁹

This case itself illuminated the problem at hand: that required environmental standards were too ambiguous. Georgia was able to get away with their plan precisely because standards were not explicitly in place, the states had the freedom to choose the "correct" amount to reduce air pollution. In an effort to fix this problem, as part of the settlement agreement, the court required the EPA to develop "a program and adhere to a schedule for promulgating, for 21 major industries, BAT effluent limitations guidelines, pretreatment standards, and new source performance standards for 65 toxic pollutants and classes of toxic pollutants."¹⁰ To develop these standards, the EPA would conduct case studies on each of the businesses production processes. One of these industries was the paper and pulp industry. This settlement agreement ultimately became the policy aspect of the MSA, as the findings from the study of the paper industry highlighted the copious amounts of waste water created from production and thus provided suggestions for lowering chemical use and requiring of certain treatment systems.¹⁰

After the study was completed, the official document was released, which provided exact details and numbers required for the paper industry to reduce their pollution. One aspect of the document stated how the paper and pulp industry must have "oxygen and peroxide enhanced extraction, which allow mills to eliminate hypochlorite *and/or* use a lower kappa factor in the first bleaching stage."¹¹ In this case, the document provided an either or situation, so most prefer to just do the latter, which does not extract the harshest chemicals like dioxin.¹¹ The document also stated how the paper and pulp industries must have "efficient biological wastewater treatment, removing 90% or more of influent five-day biochemical oxygen demand (BOD)," a process done in the secondary stage. Although this system sound productive, it should be noted that BOD does not include chlorine compounds, so the harshest chemicals, again, remain.¹¹ Thus, the

⁸ Paul Sabatier and Christopher Weible, "Chapter 2: Ambiguity and Multiple Streams," *Theories of the Policy Process*, n.d., 25 – 51.

⁹ "Train v. Natural Resources Defense Council, Inc." Oyez. Accessed December 9, 2017, <https://www.oyez.org/cases/1974/73-1742>.

¹⁰ Development Document for Effluent Limitations Guidelines and Standards for the Pulp, Paper, and Paperboard and the Builders' Paper and Boards Mills," Environmental Protection Agency, 1982, <https://www.epa.gov/sites/production/files/2016-07/documents/pulp-paper-dd-1982.pdf>

politics, or the industry’s response to the document, has been to perform the bare minimum and find ways to manipulate the current document in order to pay less and save time.

Policy Tools

The EPA’s Permit Guidance Document, a section of the NPDES permits, is one of the primary policy

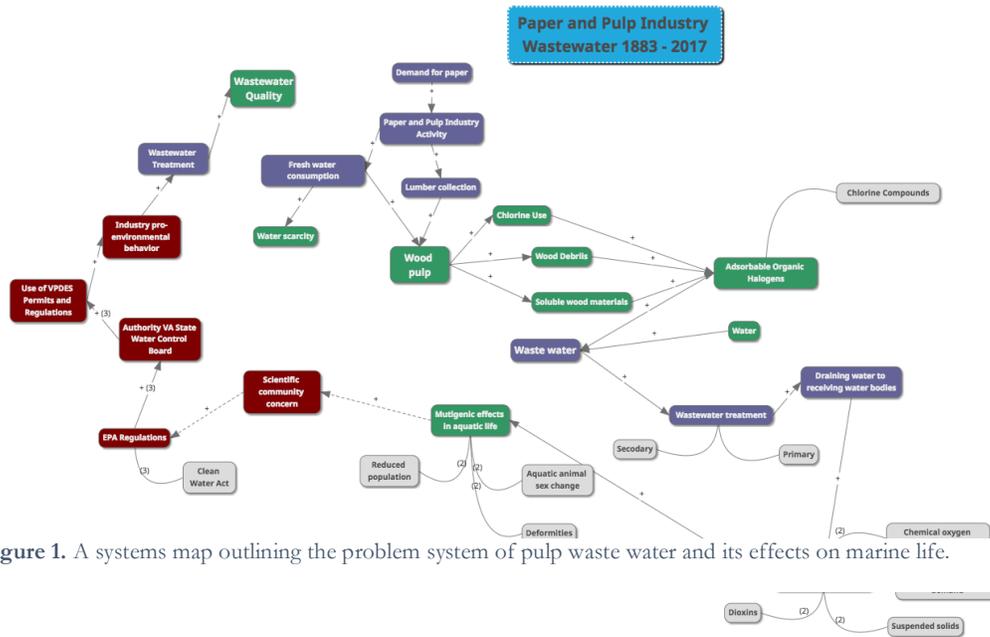


Figure 1. A systems map outlining the problem system of pulp waste water and its effects on marine life.

programs created to regulate the paper and pulp industry’s waste water because, under the Clean Water act, discharging pollutants through a point-source into a water body is illegal unless they have an NPDES permit.¹¹ These permits contain information on what is an acceptable amount and type of discharge.¹¹ As such, the largest policy tool used in the policy program, the NPDES, are permits. Since the paper making process heavily relies on toxic chemicals, these permits are primarily meant to address the “discharge limits and conditions” for which discharge can be emitted from municipal waste water treatment facilities to U.S. waterways.

Not only do these permits spell out the amount and type of pollution acceptable for drainage, the permits require the use of primary and secondary waste water treatment for industries who produce waste water. It is specifically targeting the “draining of water to receiving water bodies” aspect of the problem system (see Figure 1).¹¹

As such, these permits have high directness, as the EPA and the state directly oversee the permit’s and their appropriate execution. They monitor the permits in numerous ways: by requiring facilities to test their discharge and submit the findings to the EPA and the state for review, requiring the facility to inform the EPA and the state regulatory agency if the facility isn’t complying with the permit, and the EPA also sends inspectors to determine if facilities are being honest in their agreement to comply with the permits.¹¹

¹¹ “National Pollutant Discharge Elimination System (NPDES),” *Environmental Protection Agency*, <https://www.epa.gov/npdes/national-pretreatment-program>

Additionally, there is high coerciveness involved with this policy tool. If an industry is creating waste water in any form, the law prevents them from simply dumping it into the local waterways, the only way industries can rid their waste is through obtaining NPDES permits.¹¹ Thus, industry has no choice but to apply for these permits and uphold them, as the federal law grants the EPA and the state the ability to enforce actions against those who violate the permit requirements. Consequences for those who do not following permit requirements include monetary penalties, civil and criminal action like jail sentences, and even the closing of the treatment systems.¹¹ Finally, this policy tool has high automaticity because the policy tool utilizes a preexisting governing body, the EPA and state regulatory systems, to enforce these permits.

Problem Analysis

Once the policy programs are understood, it is worth analyzing the problem in terms of Peters' Evidence-Based Problem Analysis, which consists of looking at the problem's solubility, complexity, scale, monetarization, and interdependencies.

Solubility

The problem of improperly treated waste water entering freshwater systems producing mutagenic effects on aquatic marine life and potential harms for humans ultimately comes down to water treatment quality. Currently, permits only require two forms of waste water treatment; however, there is new technology that has created more enhanced treatment systems that can further purify contaminated water. These systems are called tertiary waste water treatment systems.¹² Tertiary treatment would be the final cleaning process, it can remove up to 99% of all impurities from waste water and is predominantly used to remove organic pollution, but it targets all remaining chemicals.¹³ Requiring these types of systems in addition to primary and secondary waste water treatment systems would further reduce dioxin rates in waterways; however, this system is still not a perfect solution because chemicals still seep through current tertiary wastewater treatment systems.¹³ Thus, the situation appears to be chronic as technology has not yet improved enough to provide the industry with fully treatable systems. As such, the problem at hand has low solubility.

Complexity

When analyzing the problem and potential solutions, it is important to consider all the agents involved.¹⁴ With the paper and pulp industry, there are the employees who work at the mills, the paper mill company, and the lumber industry who supply the wood. These actors will want to protect their personal finances that could be effected with an additional waste water treatment mandate under the NPDES permits; whereas other agents like the EPA, the State Water Control Board, and local communities near fresh water systems may prefer that the industry prioritizes the quality of water they are releasing back into nearby watersheds. As such, the political complexity of the situation is present—there will be different understandings of what is important to prioritize to solve the mutagenic effects of marine life and to reduce the harm posed to nearby communities. As such, there appears to be high political complexity as the two opposing “sides” are dramatically different.

Additionally, the paper and pulp industry process is highly technical. There are numerous pulp making processes, some chemical and other mechanical, where certain chemicals are used more frequently in certain processes than others. It becomes challenging to differentiate between processes and to fully understand the paper making process. Thus, there is high technical complexity, which can also make it a challenge to understand the causation between the paper and pulp industry and mutagenic effects on marine life if one does not fully understand the process. Collectively, there appears to be high programmatic complexity.

¹² “Wastewater Treatment Plant Virtual Tour,” Sydney Water, <https://www.sydneywater.com.au/Education/Tours/virtualtour/html/tertiary-treatment.html>

¹³ Omar Malik, “Primary vs. Secondary: Types of Wastewater Treatment,” *Environmental Performance Index*, 2014, <http://archive.epi.yale.edu/case-study/primary-vs-secondary-types-wastewater-treatment#Florke>

Scale

When thinking about the scale of the problem, it is important to think of whether the situation can be approached incrementally.¹⁴ In almost every problem, the answer is yes.¹⁴ Including this situation, as the problem is viewed as a point-source pollution problem and thus should be solved in an incremental fashion. In other words, addressing this point-source pollution does not require an “all or nothing” solution, like ridding the paper industry; instead, many steps like research, official studies, and amended legislation are required to protect and reduce risks posed by this industry.¹⁴

In addition to the solution being incremental, the magnitude of the problem is small as discharge concerns are limited only to where paper products are being produced. So, the range of effects produced by the paper industry’s waste water are small. As such, the scale of the problem is also small.

Monetization

Money is always a useful tool to disentangle a problem, however, we must consider the extent to which money can solve a problem.¹⁴ In this case, money does play a significant role, as adding tertiary treatment systems would require financing from the industry. Since the problem is framed in terms of inadequate waste water treatment systems, the solution requires facilities to purchase better and more innovative technology to produce cleaner water. Thus, monetization is high for this problem.

Interdependencies

When considering interdependencies, it is important to consider whether the key causal mechanisms are linked to multiple policy domains.¹⁴ Since the problem of paper and pulp waste water polluting freshwater systems is specific to the use of chlorinated compounds in the process of creating pulp, there are not many policy domains involved. Thus, there is low interdependencies since this point-source pollution is known to come directly from the use of toxic chemicals by the industry.

Policy Tool Evaluation

After analyzing the problem attributes, it is important to consider how the existing policy tools effect the problem, specifically considering the NPDES’s effectiveness, equity, efficiency, and the manageability of the permit.

Effectiveness

Effectiveness refers to the extent in which an activity achieves its intended goal.¹⁵ When considering the NPDES permits, I would argue they are a relatively effective tools. The goal of the NPDES permits are to ensure municipal discharge does not hurt water quality or people’s health.¹¹ Since their implementation, the amount of chemicals entering waterways have dramatically decreased.¹¹ As such, it appears they are meeting their goal.

Additionally, although these permits aren’t perfect, they leave no room for ambiguity—a primary aspect of having an effective policy tool.¹⁵ The NPDES permits specifically articulate the precise number of discharge that may enter a freshwater system and the exact type of municipal waste that is allowable. Additionally, they explain clearly and explicitly the types of treatment systems required of industries that wish to discharge waste water.

¹⁴ Guy Peters, “The Problem of Policy Problems,” *Journal of Comparative Policy Analysis: Research and Practice*, 2005, 349 – 370.

¹⁵ Lester Salamon, “The New Governance and the Tools of Public Action: An Introduction,” *Fordham Urban Law Journal*, Volume 28, Issue 5, 2000, 1647 – 1666.

Furthermore, the permits target the part of the paper making process that is causing the most damage to freshwater systems: the treatment—so the tool is targeting the circumstance that is causing the problem, making it more effective at reducing the amount of chemicals that are entering freshwater systems. Overall, this permit is achieving its intended goal to reduce harm on local ecosystems; however, it is by no means perfect, so I would argue the effectiveness of these permits could be improved to achieve their goal by implementing tertiary systems.

Equity

Equity refers to the ways in which a policy's rules are distributed to those involved.¹⁵ There are two types of equity, distributive and redistributive. Distributive programs allocate policy evenly and redistributive allocate policy differently to favor those who are disadvantaged, like small businesses.¹⁵

In the case of NPDES permits, where all permits specify acceptable levels of pollutants and parameters for *all* municipal waste, I would label it as a distributive program because of the unified rules established for all municipal discharge. Certain industries are not targeted more than others, regardless of size; instead, NPDES permits provide guidelines for all industry's that produce municipal waste and provide set standards. For example, all municipalities are required to have two major types of sewer systems: combined sewers and separate sanitary sewers.¹¹ Thus, the permits distributed the weight equally.

Efficiency

Efficiency pertains to the costs associated with a program's benefits.¹⁵ As discussed above, NPDES permits require two forms of treatment for contaminated waste water. Indeed, there can be high costs associated with the technology required for purifying waste water, not to mention the industry already pays an increasing price for water, as water is required for 85% of the paper making process.¹

However, NPDES permits only require a “minimum level of treatment of pollutions for point source discharges based on available treatment technologies...”¹¹ So industries can utilize cheaper technology, it does not need to be the most expensive system or even additional systems to fully purify water; as long as they have a primary and secondary system and the technology qualifies as a minimum level of treatment, the industry is abiding by NPDES permits. As such, the costs and the benefits are able to even out for the industry—there is a reduction in the amount of pollutants being discharged and the cost of technology to reduce these pollutants is not astronomically expensive.

Manageability

Manageability refers to the tools and resources available that allow a program to be easily executed.¹⁵ In the case of NPDES, the EPA provides a plethora of tools for industries to reference in order to successfully execute their permits: NPDES training, Enforcement and Compliance History Online (ECHO), specific guidelines with the exact amount of discharge that can be emitted, suggestions for BMPs that can assist in reducing the amount of discharge, and more.¹¹

These permits have been around since 1972 and are continuously updated with new standards about every six years.¹¹ The reason NPDES permits appear to be sustainable since the 70s is, in part, due to their manageability. These permits are relatively straight forward: you can only discharge this amount of pollution with x amount of chemicals in it. If you don't, there will be consequences. As such, these permits are not complex tools, and they only involve two actors, the EPA and state regulators. These two factors, along with the numerous tools available to industries provided by the EPA, illustrate that this program is manageable.

Recommendations

Although the current policy program, NPDES permits, are an effective first step at addressing the problem of inadequate waste water treatment, I would recommend an additional policy tool. Specifically, I would recommend implementing a market-based approach and/or a command and control approach, since most of the guidelines for in the NPDES are not being completed in thorough fashions in order to save money.

Market-Based Approach Ideas

My initial thought was to recommend a chlorine-tax, something that would operate similarly to a carbon-tax. Since there is low interdependency, meaning the problem is one of point-source pollution, we can easily identify that chlorine is the problem stemming from the industry. Water could be tested after going through the treatment processes and analyzed for the amount of chlorine left in the water, the amount left would be given an arbitrary cost associated with it and then the company would be responsible for paying for the amount of chlorine left in the water. However, this wouldn't be the most equal solution, as the tax would most likely effect large paper industries more so than smaller paper industries. Furthermore, the scale of the problem is relatively small, so the tax would be hard hitting on a relatively small industry. However, there is high monetarization associated with the problem, so an economic burden may be the only way to address the problem, which means inequity may have to occur. Although I am fond of this idea, the paper industry is not responsible for the fact that technology has not improved enough to eradicate all chemicals from contaminated waste water, so this is not an entirely fair policy tool idea.

Instead, I think a user charge could be more effective. Typically, a user charge raises funds to cover costs of management and maintenance of a resource, like having an entrance fee when going to a National Park.¹⁶ In this situation, I would recommend a tax rate that is determined per gallon of chlorine found in freshwater systems after treatment. Having this user charge would accomplish two things: it would likely reduce the amount of paper produced as consumers would reduce their consumption due to the price increase and the money raised from the increased cost of the product would allow for the industry to purchase better treatment systems or additional systems to prevent consumers from paying extra. This tax could be regulated by the federal government, the EPA specifically, as they already manage the permits for the paper industry, so the tool could have high manageability and automaticity. Again though, this tax would be hard hitting for the paper industry since the scale of the issue remains small and people would most likely be deterred by increased paper prices.

Command and Control Ideas

Since the scale of the problem is small, there is high monetarization associated with any proposed solution, and equity is likely to remain a problem with market-based approaches, there is always the possibility of having a traditional command and control approach. Command and control instruments have limited flexibility in how one achieves a goal, it typically establishes clear standards and rules to follow.¹⁶ For this situation, I think an amendment to the NPDES permits in which they require *three* types of water treatment systems—primary, secondary, and tertiary system—would work best.

As previously mentioned, the technology to fully purify waste water is just not up to par yet, making the solubility of the problem low; however, the technology that does exist can significantly reduce the amount of remaining chlorine compounds found in treated pulp water, it is just not required by the NPDES. This amendment would have high automaticity since the EPA and the state already regulate treatment requirements, which also indicates high directness. This would further reduce chlorine compounds found in waste water, however, it provides no incentives for industries to look further into new innovative solutions. Thus, the real solution, at least a short-term solution, would be to combine the idea of amending NPDES permits and suggesting market-based approaches to coincide with it.

Conclusion

¹⁶ Robert Stavins, "Market-Based Environmental Policies," *Resources for the Future*, 1998, 1 – 36.

Due to the static history of the paper and pulp industry, the process of paper making does not appear to be altering any time soon. Additionally, even with the advancement of technology, our society's demand for paper and paper products continue to rise. As such, the vast use of chemicals entering waste water will continue to be a problem. To address the effects harsh chemicals are having on freshwater systems, it would be an efficient solution to target the treatment of waste water rather than the alteration of the industry and the societal demand for paper.

As such, the NPDES permits are an excellent start to addressing the problem, and continue to improve each year they are updated. However, more regulation is required to better protect freshwater ecosystems and surrounding communities. To accurately assign a new policy tool this issue, though, requires thorough investigation of the problem's history and its attributes, as well as how these two aspects correspond with certain policy tools. I have provided my own ideas about what is the most efficient solution to address the environmental impacts of the paper and pulp industry on aquatic marine life and the surrounding communities. However, the industry produces significantly more environmental effects than just contaminated waste water, so this should not be the only improvement to the industry. Further systems maps and analysis are needed to understand and identify solutions to industry produced problems to air quality, deforestation, and resource depletion.