2015

Implementing POPP in Springfield, Massachusetts

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December 2015

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INTRODUCTION

To foster growth and development in cities outside Boston, a Publically-Owned Pretreatment Plant (POPP) can drastically help people who are not repeating the benefits of a growing economy. Generally, a Publically-Owned Treatment Work (POTW) is designed to treat domestic sewage only. However, POTWs also receive wastewater from industrial or non-domestic users and may receive toxic waste that it cannot fully treat to certain environmental standards. Implementing a POPP is a viable alternative to the current structure. The POPP is intended to serve as an environmental, economic, and social tool that can benefit both residents and business owners in a deserving city. If towns constructed the POPP, the costs and liabilities associated with water pollution would no longer fall on firms independently. Instead, a POPP will be a tremendous incentive for industrial businesses to relocate to towns, bringing in new jobs, tax revenue, and economic revitalization. Springfield, located in Western Massachusetts is a city that can benefit from the POPP by moving towards their goal of better employment, public services, and increased water quality for citizens and for the environment. This paper will assess the implementation of a POPP in Springfield, Massachusetts, examining the treatment processes under EPA standards, the newly proposed process, the costs, funding, benefits, and future implications of Publically-Owned Pretreatment Plant.

MILL CITIES

Springfield, Massachusetts is an ideal city for demonstrating the success a POPP can have on cities all across the United States. Springfield is referred to as a mill city and is connected to the Gateway City program. Gateway cities are cities that boomed during the 1800-1900s but are currently economically struggling.[1] Poverty in the eleven mill cities is only intensifying. For example, between 1970 and 2005, while Greater Boston added 467,000 jobs to grow by 51 percent, the Gateway Cities as a group lost more than 11,000 jobs, or 3 percent of their job base.[2] The cities also include thirty percent of all Massachusetts residents living below the poverty line despite accounting for fifteen percent of the state population.[3] Additionally, the 'unevenness' of the state's economy is creating challenges within the housing market, land-use patterns, and the labor-force. Implementing a POPP can help struggling cities like Springfield and diminish the large gap between Boston and Springfield's economy.

The traditional mill cities like Springfield are struggling with deindustrialization, and have not yet found their niche in the "specialized knowledge-based economy" that is revitalizing other parts of the state.[4] As Boston's economy continues to grow in the 'knowledge-oriented industry,' Gateway cities are losing their traditional basis in the manufacturing industry. By losing its industrial base, Massachusetts' economy as a whole is being harmed. Implementing a

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[1] Muro, M., Schneider,J., Warren, D., McLean., E., Sohmer, R., Forman, B (2007). Reconnecting Massachusetts: Gateway Cities: Lessons Learned and an Agenda for Renewal. MassInc: Research, Journalism, Civic Life. http://www.masstech.org/sites/mtc/files/documents/Gateway%20Cities%20Report.pdf

[2] Muro, M., Schneider,J., Warren, D., McLean., E., Sohmer, R., Forman, B (2007). Reconnecting Massachusetts: Gateway Cities: Lessons Learned and an Agenda for Renewal. MassInc: Research, Journalism, Civic Life. http://www.masstech.org/sites/mtc/files/documents/Gateway%20Cities%20Report.pdf

[3] Muro, M., Schneider,J., Warren, D., McLean., E., Sohmer, R., Forman, B (2007). Reconnecting Massachusetts: Gateway Cities: Lessons Learned and an Agenda for Renewal. MassInc.: Research, Journalism, Civic Life. http://www.masstech.org/sites/mtc/files/documents/Gateway%20Cities%20Report.pdf

[4] Muro, M., Schneider,J., Warren, D., McLean., E., Sohmer, R., Forman, B (2007). Reconnecting Massachusetts: Gateway Cities: Lessons Learned and an Agenda for Renewal. MassInc: Research, Journalism, Civic Life. http://www.masstech.org/sites/mtc/files/documents/Gateway%20Cities%20Report.pdf

POPP in Springfield is also an ideal economic investment because gateway cities like Springfield have the infrastructure already to support the POPP. While mill cities face certain hardships, there are plenty of opportunities that demonstrate the potential of prosperity. For example, the cities offer affordable housing, contain a youthful and diverse mobile workforce, and foster a society with a desire to grow and expand. To help the mill cities, it is important to leverage the cities' assets and use capital to attract new public and private investment.[5]

The POPP can satisfy the three recommendations the Massachusetts Institute has discussed to help connect the traditional mill cities the economic prosperity of Boston. First, the Gateway cities are recommended to partner with the state to receive aid dollars and collaborate on new projects. Second, the Institute recommends the Mill cities focus on rebuilding the middle-class workforce to improve productivity. Third, the Mill cities should create new economic connections, such as collaborating on new projects that include intergovernmental, inter-sectoral and local business work.[6] Therefore, the POPP, serving as a publically-sponsored treatment plan, would encourage collaboration among local business owners, city officials, and intergovernmental factions, reducing wastewater costs as well as improving the environmental conditions of the surrounding area, encouraging more business to relocate to Springfield.

[5] Newcombe, T., 2012. 11 Cities in Massachusetts Band Together to Solve Urban Ills. Governing Urban Notebook. http://www.governing.com/columns/urban-notebook/11-Cities-in-Massachusetts-Band-Together-to-Solve-Urban-Ills.html (accessed 15 November 2015).

[6] Muro, M., Schneider,J., Warren, D., McLean., E., Sohmer, R., Forman, B (2007). Reconnecting Massachusetts: Gateway Cities: Lessons Learned and an Agenda for Renewal. MassInc: Research, Journalism, Civic Life. http://www.masstech.org/sites/mtc/files/documents/Gateway%20Cities%20Report.pdf

SPRINGFIELD

Springfield was chosen for several reasons. First, the Connecticut River runs through Springfield. The POPP can help the river by ensuring effluent levels comply with EPA standards, reducing river contamination and pollution. Second, Springfield is a Gateway city, and its median household income is below the national income of ($40,000). Therefore, Springfield is in need of a proposal to spur economic growth. Third, Springfield contains a rich history in manufacturing and contains businesses that may benefit from using the POPP from the onset. Springfield also has enough manufacturing plants to implement the first POPP. As other manufacturing companies witness the successes and benefits of the POPP, more companies may re-locate to Springfield.

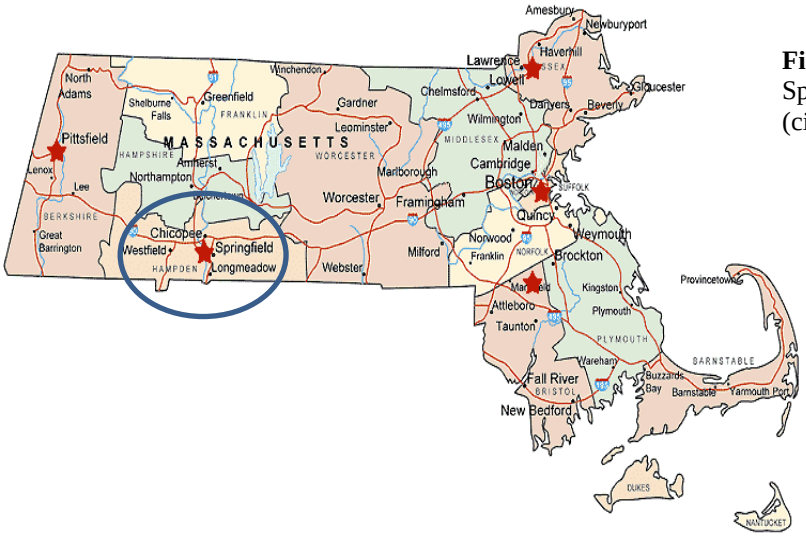

Figure 1: Map of Massachusetts State. Springfield located Southwest Massachusetts (circled)

Springfield, located in Western Massachusetts, contains the Connecticut River (figure 1).[7] Historically, the Connecticut River has been scarred by industrial wastewater and sewage

[7] Google Image. Springfield State. https://www.google.com/search?q=springfield+ma+map&espv=2&biw=2402&bih=1163&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjd7rSB8ebJAhUDqR4KHRWKBjoQ_AUIBygC&dpr=0.67 (accessed on December 17th)

contaminating the water. Organizations such as the Connecticut River Watershed Council are searching for solutions to control river waste. The Council supports new policies and legislation that will prevent waste from entering local streams and rivers and may favor the POPP.[8] For example, while the council is supporting cleanup events that remove trash along the river and stream banks, pollution and chemicals cannot be simply removed by people. Therefore, a solution like the POPP can mitigate water pollution by controlling industrial waste. River restoration work is extremely important because rivers provide habitat to many local aquatic organisms as well as provide ecological services to people and are extremely economically valuable. Thereby, harming a river and affecting the watershed health by over-polluting a river like the Connecticut River can be extremely costly in the future. Avoiding further water pollution by ensuring companies comply with the EPA standards of wastewater effluent will protect our nation's waterways like the Connecticut River.

Springfield is performing significantly worse than Massachusetts and the United States.[9] On average, those who are 25-34 are making over $50,000 throughout Massachusetts (table 1). However, in Springfield, the median household income for 25-34 is under $30,000. When comparing Springfield to the United States, the median household income for Springfield is $30,417 while the median income for the United States is over $41,000 (table 1). For the state of Massachusetts, the median income is $50,502.[10] Additionally, Springfield is a racially diverse community and different racial groups receive different incomes. In Springfield, as of 2002 black workers' per capita income is $13,263 while white workers' per capita income is $18,623 (table

[8] Fisk, A. (2014). Finding Solutions for River Pollution: Connecticut River Watershed Council Promotes Zero Waste. http://vtdigger.org/2014/09/23/finding-solutions-river-pollution-connecticut-river-watershed-council-promotes-zero-waste/ (accessed on December 17th 2015).
[9] Springfield Consensus Data (2015) United States Consensus Bureau. http://quickfacts.census.gov/qfd/states/25/2567000.html (accessed October 20th 2015).
[10] Springfield Consensus Data (2015) United States Consensus Bureau. http://quickfacts.census.gov/qfd/states/25/2567000.html (accessed October 20th 2015).

2). Overall, Springfield is substantially below the Massachusetts average per capita income. While Massachusetts has a per capita income of $25,952, Springfield has a per capita income of $15,232 (table 2) As of 2010, 21.3% of families and 26.8% of the population were below the poverty line, including 40.0% of those under age 18 and 17.5% of those ages 65 or over (table 2). Therefore, Springfield implementing a POPP can help those marginalized in Springfield as well by creating new jobs and opportunities.

Table 1: Comparison of medium household income by age (Springfield, M.A. and U.S.)[11]

Medium Household Income by Age ($)			
	Springfield	**MA**	**U.S.**
Under 25	17,723	27,364	22,679
25-34	29,869	51,855	41,414
35-44	38,723	61,304	50,654
45-54	43,141	67,287	56,300
55-64	33,225	56,669	47,447
65-74	24,551	33,589	31,368
75 +	19,830	21,522	22,259
MEDIAN	30,417	50,502	41,992

Table 2: Per Capita Income (Springfield, M.A., U.S.)[12]

Per Capita Income by Race or Ethnicity ($) 2002			
	Springfield	**MA**	**U.S.**
White	18,623	27,808	23,918
Black	13,263	16,011	14,337
Native American	11,515	15,889	12,893
Asian	11,291	21,452	21,823
Native Hawaiian	16,793	16,948	15,054
Hispanic	8,885	11,963	12,111
Two Races	10,006	14,661	13,405
Other	8,252	16,948	10,813
Per Capita Income	15,232	25,952	21,587

[11] Springfield Consensus Data (2015) United States Consensus Bureau. http://quickfacts.census.gov/qfd/states/25/2567000.html (accessed October 20th 2015).
[12] Springfield Consensus Data (2015) United States Consensus Bureau. http://quickfacts.census.gov/qfd/states/25/2567000.html (accessed October 20th 2015).

High levels of unemployment carry tremendous social and economic costs to both the unemployed and society as a whole. Thus, job creation incentives provide a mixture of social and economic benefits. The construction of the POPP will provide new jobs in three ways. First, the construction and operation of the POPP will require labor. Workers will be needed to construct the facility and later skilled laborers will be needed to operate the facility. The biggest advance in job creation will be from the firms that relocate to the community. These jobs, hopefully at technology companies or in the technology production sector, can provide job growth with strong wages to raise the median household income.[13] Second, jobs in the manufacturing industry pay higher wages, on average, than the 14 new jobs being created in the information sector of the Silicon Valley. Manufacturing positions also train employees with highly demanded skills that could help them find new employment in the future if necessary.[14] Third, reciprocal job growth may occur because as the local economy grows stronger more jobs will be created in the service sector and local businesses will have a larger customer base to pull from. The direct benefits of employment empower the individual and the community.

Springfield contains rich history in manufacturing and therefore has the current infrastructure to implement a POPP. Additionally, major companies like OnCore have opened manufacturing plants in Springfield, revealing the potential for more businesses to follow. Therefore, by containing the workforce available to be employed in the proposed POPP, the current infrastructure, and the availability for more businesses, Springfield can thrive by implementing the POPP.

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[13] Massachusetts Technology Collaborative. (2014). Annual Index: Massachusetts Innovation Economy. The Innovation Institute.
[14] Kotkin, J., and Shires, M. (2014). America's New Industrial Boomtowns. Forbes. http://www.forbes.com/sites/joelkotkin/2014/06/19 (accessed on October 20th 2015).

EPA STANDARDS

The POPP can help businesses comply with Environmental Protection Agency (EPA) standards by removing the burden of businesses treating their own effluent wastewater. A main policy goal of the Clean Water Act is prohibiting the discharge of toxic amounts of pollutants into the Nation's waterways. After the CWA was passed in 1972, regulations caused firms to become more aware of what pollutants they were discharging in their wastewater. More recently, amendments to the original act and increased monitoring have placed higher levels of responsibility on businesses. Point source firms that choose to expel effluent into a surface water body have to apply for a National Pollutant Discharge Elimination System (NDPES) permit (33 U.S.C. §402).[15] EPA requires that all manufacturing point sources need to apply for a NDPES permit. NPDES permits can be time consuming and costly because they require firms to monitor their own pollutant levels and filters out toxic pollutants to meet state and local contamination standards.

In the current system of direct discharge under a NPDES permit, the effluent has to be treated by the discharger according to the treatment determined to be the best available technology standard for that industry's discharge of a particular kind of pollutant.[16] To channel waste into a POTW, discharge must be pretreated to be properly treatable by the POTW's treatment facilities before being discharged by the POTW under the POTW's NPDES permit. In summary, if toxic constituents, companies can either directly discharge under a NPDES permit and assume the responsibility to treat the waste according to the best available technology

[15] National Pollutant Discharge Elimination System (NPDES). (2014). http://www.waterboards.ca.gov/water_issues/programs/npdes/pretreat.shtml (accessed on December 2nd 2015).
[16] National Pollutant Discharge Elimination System (NPDES). (2014). http://www.waterboards.ca.gov/water_issues/programs/npdes/pretreat.shtml (accessed on December 2nd 2015).

standard or the companies would channel the waste into a POTW.[17] Under the latter, the companies would still have to pre-treat the waste to be properly treatable by the POTW's treatment facilities before being discharged. Therefore, while companies have various options to treat the waste, they are still left with the burden of properly handling the waste that is produced during the manufacturing process.

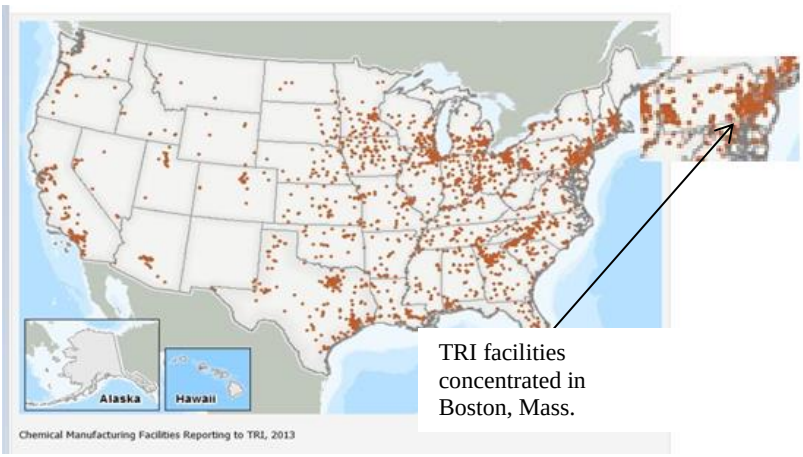
The EPA's regulations seek to address the issue of toxic discharge. Yet, due to conflicting interests and a lack of resources, high-level regulation falls short and hundreds of millions of pounds of unaccounted for and untreated toxic pollutants continue to be discharged each year. Also, because the EPA has limited resources to spend on confirming each firm's pollutant report, the permits threaten local water bodies because they allow firms to discharge with minimal supervision.[18] The POPP relieves industrial facilities of strict regulatory requirements by having the businesses send their wastewater to a publically owned pretreatment facility that treats chemical waste before entering the POTW system. The POPP will also help the EPA regulate the untreated toxic pollutants that would otherwise contaminate rivers and other waterways. To alleviate this burden, a POPP would greatly help certain manufacturing companies as well as benefit the residents of the community and the environment. The POPP would take over the task of pre-treating wastes that go into a POTW and relieve the manufacturing companies from having to get their own NPDES treatment permit. Additionally, community residents will be ensured a safer toxic pollution management system.

[17] National Pollutant Discharge Elimination System (NPDES). (2014). http://www.waterboards.ca.gov/water_issues/programs/npdes/pretreat.shtml (accessed on December 2nd 2015).
[18] Collins, C. (2010). Toxic Loopholes: Failures and Future Prospects for Environmental Law. Cambridge, U.K.: Cambridge University Press.

CHEMICAL MANUFACTURE

Many chemical manufacturing facilities are located near Boston and the greater Boston region (figure 2). It is also apparent that Western Massachusetts is lacking such heavy manufacturing industries. To encourage more manufacturing industries to move to areas like Western Massachusetts, a POPP can diminish the burden companies have. In particular, we plan to focus on the chemical manufacturing industry in Massachusetts.[19]

Figure 2: TRI Facilities in the United States zoomed in on Massachusetts. TRI facilities are heavily concentrated in the Boston region, while Western Massachusetts has fewer facilities. The POPP can encourage more TRI facilities to re-locate to Western Massachusetts.[20]



While chemical manufacturing is extremely prevalent in the Greater Boston region, there are not many chemical manufacturing plants spread throughout the Massachusetts state. Therefore, to encourage more manufacturing companies to move to mill cities like Springfield, a POPP will help businesses deal with the costs of manufacturing materials like plastic. Additionally, the POPP will encourage new businesses to manufacture in areas like Springfield as they will not have to spend the money to treat their own wastewater.

[19] Chemical Manufacturing Sector: NAICS 325 (2015). Environmental Protection Agency. http://www2.epa.gov/regulatory-information-sector/chemical-manufacturing-sector-naics-325 (accessed November 15th 2015).

[20] TRI National Analysis (2013). Chemical Manufacturing. Environmental Protection Agency. http://www.epa.gov/toxics-release-inventory-tri-program/2013-tri-national-analysis-chemical-manufacturing (accessed November 28th 2015).

Under the EPA, Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) include wastewater discharges from the manufacture of certain products like: [21]

- SIC 2821 – Plastic Materials, Synthetic Resins, and Non-vulcanizable Elastomers
- SIC 2823 – Cellulosic Man-Made Fibers
- SIC 2824 – Synthetic Organic Fibers, Except Cellulosic
- SIC 2865 – Cyclic Crudes and Intermediates, Dyes, and Organic Pigments
- SIC 2869 – Industrial Organic Chemicals, Not Elsewhere Classified
- 22 Organic Chemicals, Plastics, and Synthetic Fibers 414 B–H, K PSES PSNS Limits are mass-based (concentration based standards multiplied by process flow) daily maximums and monthly averages. Standards for metals and cyanide apply only to metal- or cyanide bearing waste streams.

EPA selected the OCPSF category (40 CFR Part 414) for a more detailed review. This category ranked highest in reported pollutant discharges among all industrial point source categories.

Table 3: Number of TRI Facilities in Massachusetts[22]

	Springfield, MA	United States
Number of TRI Facilities	67	21,897
Total Production-Related Waste Managed	53.4 million lbs.	25.0 billion lbs.
Total On-Site and Off-Site Disposal or Other Releases	3.2 million lbs.	4.1 billion lbs.
Total on Site	2.0 million lbs.	3.7 billion lbs.
- air	1.5 million lbs.	772.5 million lbs.
- water	86.6 thousand lbs.	213.2 million lbs.
- land	434.3 thousand lbs.	2.7 billion lbs.
Total off site	1.2 million lbs.	449.2 million lbs.

[21] Organic Chemicals, Plastics and Synthetic Fibers Effluent Guidelines (2015). Environmental Protection Agency. http://www.epa.gov/eg/organic-chemicals-plastics-and-synthetic-fibers-effluent-guidelines (accessed December 2nd 2015).

[22] TRI Facilities in Springfield, MA. Environmental Protection Agency. http://iaspub.epa.gov/triexplorer/tri_factsheet.factsheet?&pstate=MA&pcity=Springfield&pyear=2013&pDataSet=TRIQ1 (accessed November 23rd 2015).

In particular, Springfield has sixty-seven TRI facilities, discharging 53.4 million pounds of waste (table 3).[23] Offsite release is approximately 1.2 million pounds 0.2% of the total off-site waste disposal in America (table 3).Chemical manufacturers produce a variety of products, including basic chemicals, products used by other manufacturers (such as synthetic fibers, plastics, and pigments), and consumer products (such as paints, fertilizers, drugs, and cosmetics). In 2013, over three-thousand chemical manufacturing facilities reported to TRI; more than any other sector. This sector reported 42% of the TRI production-related waste managed; also more than any other sector.[24] The POPP can target TRI facilities like plastic manufacturing in order to help them comply with the standards set by the EPA. Since companies have to pay to get permits to even treat waste off-site, removing the cost of obtaining permits to send wastewater to off-site locations like POTWs can lure companies into relocating to cities that have a POPP.

[23] TRI Facilities in Springfield, MA. http://iaspub.epa.gov/triexplorer/tri_factsheet.factsheet?&pstate=MA&pcity=Springfield&pyear=2013&pDataSet=TRIQ1

[24] 2013 TRI Factsheet: City – Springfield, MA (2015). Environmental Protection Agency. http://www2.epa.gov/toxics-release-inventory-tri-program/2013-tri-national-analysis-chemical-manufacturing (accessed November 15th 2015).

TRADITIONAL VERSUS PROPOSED PLAN

Table 4: Two plastic manufacturing companies in Springfield, general information[25][26]

Company name	New Frontier Plastic Co.	Plastic Packaging Corporation
Address	Address: 380 Union Street, Springfield MA 01089-4127	Address: 1227 Union Street, West Springfield, MA 01089
General information	New Frontier is a Plastics Extrusion Manufacturers	PLACON is a Northern American designer and manufacturer of custom stock thin gauge thermoformed plastic clamshells, trays, and blisters with a line of recycled PET materials

Manufacturing companies like New Frontier Plastic Co. and Plastic Packing Corporation (PLACON), that are located in Springfield, can implement the POPP (table 4). Companies are required to "pretreat" their wastes, prior to discharge to POTWs, to prevent interference or upset to the operation of the POTW. The Federal program also requires many indirect dischargers to meet technology-based requirements. Under the traditional system, wastewater collected in indoor drains flows to a POTW where it is treated prior to being released into the environment (figure 3 process #1), while storm water collected in drains in the parking lot flows directly into surface waters (figure 3 process #6).[27] The POPP can benefit the environment and serve the companies by requiring all wastewater to be treated by the best available technology under the POPP's infrastructure.

[25] Cortera Business Inventory. New Frontier Plastic Co. (2015). https://start.cortera.com/company/research/k3p0oxm2r/new-frontier-plastic-co/ (accessed on November 11th 2015).
[26] Yellowpages. Plastic Packaging Corporation. (2015). http://www.yellowpages.com/west-springfield-ma/mip/plastic-packaging-corp-1508371 (accessed on November 12th 2015).
[27] Explore a TRI Facility (2015). Environmental Protection Agency. http://www.epa.gov/toxics-release-inventory-tri-program/explore-tri-facility. (Accessed December 16th 2015).

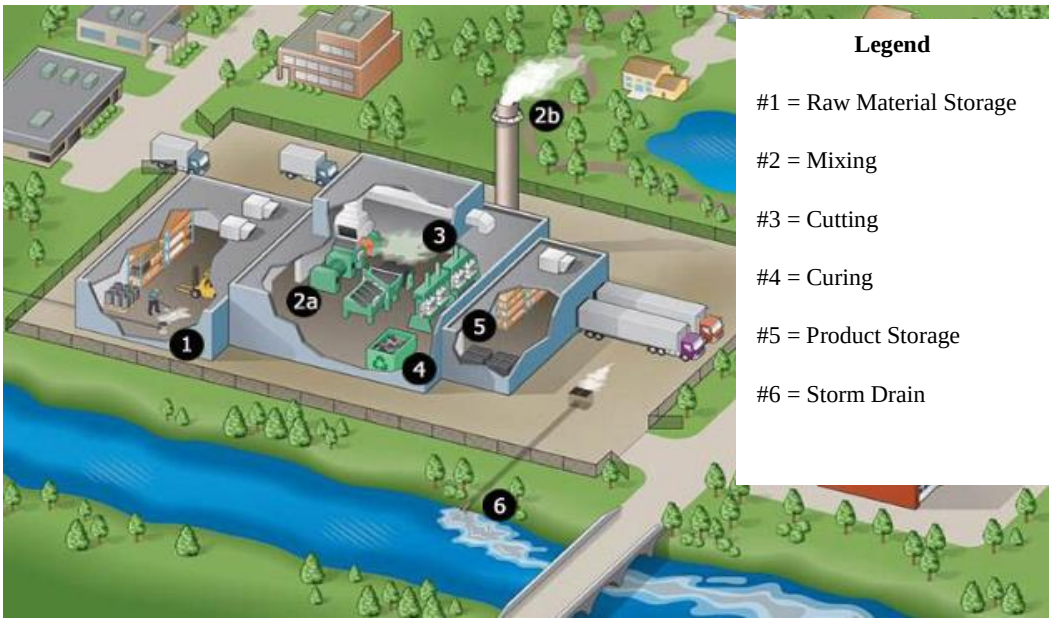


Figure 3: Traditional Wastewater Discharge (POTW/NPDES)

Table 5: Explanation of the TRI Facility Processes (1-6)[28]

	Process
1	Raw Material Storage: The facility keeps raw materials in a storage room, materials that are used to improve the chemical characteristics of the product. To clean spills, the floors are mopped and wastewater is washed down a drain that feeds into a pipe leading to a POTW.
2	Mixing: The facility combines different raw materials. When gases are produced, the gases are collected in a fume hood above the mixer, and then routed through a pollution control device to capture the chemicals and prevent release. The gases that are not properly collected are released outside through a smokestack
3	Cutting: The facility cuts large material into smaller pieces, which often causes tiny particles containing PACs to enter the air inside the facility. The air containing the PAC particles flow outside the facility. TRI facilities report the escape as a fugitive air release.
4	Curing: The facility cures material under heat and pressure into molds. After curing, the byproduct containing lead, zinc, and PACs are transferred to an off-site waste management company for recycling (off-site transfer)
5	Product Storage: The facility packages and ships products for sale to consumers. While the products still contain lead, zinc, and PACs compounds, the quantities in the product are not reported to the TRI. TRI does not contain information on quantities of chemicals contained in products sold to consumers.
6	Storm Drain: At the facility, lead, zinc, and PAC may spill onto the ground. Rain washing the spills will carry the chemicals into storm drains and pipes that discharge into local waterbodies like rivers. TRI facilities report spills as surface water discharge.

[28] Explore a TRI Facility (2015). Environmental Protection Agency. http://www.epa.gov/toxics-release-inventory-tri-program/explore-tri-facility. (Accessed December 16th 2015).

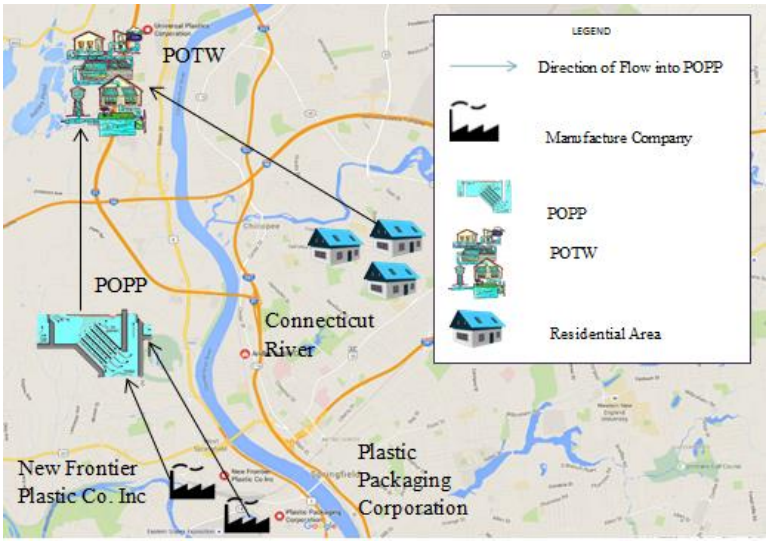


Figure 4: New Proposed process for the two companies, New Frontier Plastic Co. and Plastic Packaging Corporation, the POPP being the intermediary between the companies and the POTW. Residential areas directly emit their wastewater to the POTW.

Table 6: List of Chemicals treatable by the POPP for manufacture businesses like New Frontier Plastic[29]

Chemicals	
♦ 1,1- Dichloroethane	♦ Ethylbenzene
♦ 1,1- Dichloroethylene	♦ Fluoranthene
♦ 1,1,1- Trichloroethane	♦ Fluoranthene
♦ 1,1,2- Trichloroethane	♦ Fluoranthene
♦ 1,2- Dichlorobenzene	♦ Hexachlorobenzene
♦ 1,2- Dichloroethane	♦ Hexachlorocyclo pentadiene
♦ 4,6-Dinitro-ocresol	♦ Hexachloroethane
♦ 2-Nitrophenol	♦ Lead
♦ 4-Nitrophenol	♦ Methyl chloride
♦ Acenaphthene	♦ Methylene chloride
♦ Anthracene	♦ Naphthalene
♦ Benzene	♦ Nitrobenzene
♦ Bis (2-ethylhexyl) phthalate	♦ Phenanthrene
♦ Carbon tetrachloride	♦ Pyrene
♦ Chlorobenzene	♦ Tetrachloroethylene
♦ Chloroethane	♦ Tetrachloroguaiacol

[29] EPA National Analysis Executive Summary
http://www2.epa.gov/sites/production/files/documents/2001_national_analysis_tive_summary.pdf

Manufacturing companies like New Frontier Plastic Co. and Plastic Packing Corporation (PLACON), that are located in Springfield, can implement the POPP. The proposed POPP can help treat chemicals like cyanide and vinyl chloride (table 6) to avoid harmful contamination of rivers and other large waterways that the EPA is regulating (figure 4). In the new method, the companies will directly send their wastewater to the POPP that will treat the water before sending it to the POTW. The POTW will only receive direct, non-treated wastewater from residential areas. The pretreatment solution, however will serve as the intermediary between industrial users and the POTWs. The plan will enforce effective treatment of toxic pollutants that are often emitted from the chemical manufacturing process of producing plastics.

COSTS

Costs to consider in building a POPP include the construction costs as well as the on-going costs to operate and maintain the facility. There are several variables that play a factor in the overall cost to construct and operate a water pre-treatment facility and, in general, include the following[30][31]:

Factors to Consider for Construction

- Treatment Requirements (will be determined on a case by case basis with the participating manufacturing companies and dictates equipment needs and structural design as described):
  - Type and level of contaminate within the input wastewater
  - Desired level of contaminate within output wastewater
- Equipment & Space Requirements:
  - Costs to acquire the land where the structure will be placed
  - Conveyance costs between the POPP and manufacturing facilities as well as to the POTW (intake and distribution pipelines will be greater if POPP is located farther away from these entities)
  - Size and required square footage of the POPP structure
  - Capacity requirements – gallons of wastewater to be treated per day (this will vary with the size and processing capacity of the manufacturers within the POPP network)
  - Quality of material to be used for the equipment. There are different levels of quality for the materials which needs to be considered based on the contaminate within the wastewater since certain chemicals can react poorly with different types of materials (if the proper quality is not used this will increase maintenance and repair costs later on)

[30] Work Breakdown Structure-Based Cost Models for Drinking Water Treatment Technologies (2014). Environmental Protection Agency. http://www.wastewaterhandbook.com/documents/optimized_design/1012_costing.pdf (accessed on December 3rd 2015).

[31] Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod (2010). Barnstable County Wastewater Task Force.

- Control systems needed to ensure quality of treatment process and trouble-shooting needs

- Other Requirements:
  - Start-up costs: other maintenance and lab equipment or supplies, hiring and training employees
  - Permitting and environmental impact assessments
  - Engineering and design fees

<u>On-going Operation and Maintenance:</u>

- Personnel to operate and maintain equipment as well as continually test effectiveness of treatment process
- Operational supplies and chemicals utilized during the treatment process
- Facility costs such as electricity, repairs and maintenance
- Sludge disposal
- Regulatory expenses such as taxes and insurance
- Loan servicing & other financing costs associated with the construction of the facility

Table 7: Potential costs to consider for POPP construction

Waste, Water, and Treatment Plan			
Equalization Basin	**Pump Station**	**Control Building**	**General Construction**
Mobilization	Set precast and station	Fill	Concrete
Equipment set up	Backfill	Excavate and pour	Set equipment
Walk-way	Set-pump and vault	Floor Level	Piping
Excavate and backfill	Piping	Pipe and Electric Under slab	Electric
Entrance	Electric	Form and Pour Slab	Roads
Form and pour slab		Masonry and opening	Fence
Form and pour walls		Roof Framing	Finish Grade and Seed
Form and pour walks		Plumbing	Startup
Backfill		HVAC and electric	Project Substantial completion
Electric		Finishes	Engineer and Control
Paint and finishes		Fill Site	Strip Topsoil
			Evacuate and Fill

There are several models available that could be used to determine a construction, on-going operations and rehabilitation or repair costs (table 7). The EPA developed a costing model for wastewater treatment technology by combining historical data and resources due to the fact that "the Safe Drinking Water Act Amendments of 1996, as well as a number of other statutes and executive orders, require that the U.S. Environmental Protection Agency (EPA or the Agency) estimate regulatory compliance cost as part of its rulemaking process."[32] The complex model is based on a work breakdown structure (WBS) focusing on each of the aforementioned factors for construction and operating costs to calculate total costs for a water treatment facility. While this guide relates to treatment for drinking water, the process and characteristics of the treatment would be similar and could be used as a guide for a WBS costing method for wastewater treatment. Once total costs are determined they are typically compared amongst alternatives by calculating the cost per unit volume (typically gallons in the United States) of wastewater treated. Through several studies performed by the EPA and other water treatment facility engineers, costs per unit volume typically decrease as the size of the facility increases due to economies of scale, (table 8).[33] However, the benefits from economies of scale have to be weighed against construction and maintenance costs of a larger facility.

Table 8: Average treatment costs (unit construction and O&M costs by capacity in gallons per day; gpd

Capacity	Unit Construction Cost	Unit O&M Costs
10,000 gpd	$70 per gpd of capacity	$13 per gpd of average flow
100,000 gpd	$35 per gpd of capacity	$5 per gpd of average flow
1,000,000 gpd	$17 per gpd of capacity	$2 per gpd of average flow

[32] Work Breakdown Structure-Based Cost Models for Drinking Water Treatment Technologies (2014). Environmental Protection Agency.
[33] Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod. (2013). County of Barnstable. http://www.ccwpc.org/index.php/component/content/article/36-wastewater-reports/78-comparison-of-costs-for-wastewater-management-systems-applicable-to-cape-cod (accessed on December 2nd 2015).

Due to the fact that the variables and factors to be considered for construction and operation of the POPP are highly site-specific and are based on the entities within the network (table 7), circumstances of the location and engineering design, identifying the actual costs would be difficult without a detailed consultation with an experienced contractor. Interviews would have to be conducted with the entities participating in the POPP to determine their wastewater needs and develop a system that can handle those chemicals in a more efficient manner than is currently taking place. Costs can vary greatly depending on the quality of the infrastructure, capabilities of the design and its capacity, therefore, a range of expected costs would be difficult to enumerate.

Some recent projects undertaken in the United States have publicly reported some costs associated with their facilities. For example, the town of Orleans, MA was seeking to institute a regionalization of their wastewater treatment facilities and engaged Wright-Pierce, an environmental engineering firm, to perform a study on the estimated costs to facilitate such a project. In this study, the Town of Brewster, MA was planning for a new wastewater treatment facility and nitrogen removal process and determined that to process 183k gallons/day it would cost $14.2M in construction costs, plus $405k per annum for operational costs.[34] Additionally, the Town of Orleans, MA was to implement a similar structure at a grander scale to process 1.1 million gallons/day at a construction cost of $42.5M and an operational cost of $1.1 million per annum. This example demonstrates that capital outlays decrease with the increase of capacity since the Orleans project has the capacity of approximately six times more waste per day than the Brewster project, yet has a cost increase by a factor of less than three. As such, ideally the POPP would incorporate as many participants as possible to increase capacity allowances and thus decrease cost per treatment for each of its constituents making the undertaking more feasible.

[34] Wright, P. (2009). Town of Orleans, Wastewater Regionalization Study Orleans-Brewster-Eastham.

FUNDING

Funding for the Gateway cities: Recently $339 million was allotted to Gateway Cities, a 3.06% increase in local aid. A few Gateway Cities are also receiving aid from the Federal Reserve Bank of Boston in support of initiatives that 'foster collaborative leadership.[35] Springfield is currently set to receive the second largest amount funding (almost $35M) for economic development projects under this program. There various additional forms of financing possibilities for needed capital investment and on-going operations with regards to the POPP.

The aid gateway cities like Springfield are receiving can be used towards the cost of manufacturing the POPP by submitting an application for several different grants. These grants include the MassWorks Infrastructure Program which "provides public infrastructure funding to support economic development."[36] In addition, another entity, Mass Development, provides other financing solutions, such as bond financing and gateway city loans, by partnering with bank and state agencies to support growth and development in communities of need.[37] Under bond financing, eligible infrastructure with capital needs in the range of $5 million to $50 million includes wastewater facilities. The POPP could be financed by combining various programs within these funding mechanisms to cover a larger proportion of the capital requirements as long as the eligibility criteria are satisfied and economic viability can be proven.

Other national programs, such as the EPA, have several options for grants relating to projects that improve water quality and infrastructure constructed for water treatment. Specifically, there is the Clean Water State Revolving Fund ("CWSRF") which is "a federal-

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[35] Mass Inc. Budget Takeaways for Gateway Cities (2015). http://www.massinc.org/INCSpot/Fiscal-2016-Budget-Takeaways-for-Gateway-Cities.aspx (accessed on November 18th 2015).

[36] MassWorks Infrastructure Program. http://www.mass.gov/hed/economic/eohed/pro/infrastructure/massworks/ (accessed on November 28th 2015).

[37] Financing Mass Development. (2015). http://www.massdevelopment.com/what-we-offer/financing/ (accessed on November 29th 2015).

state partnership that provides communities a permanent, independent source of low-cost financing for a wide range of water quality infrastructure projects."[38] Under this program, the EPA provides grants to all states which independently manage their own respective programs and determine which projects to fund. The total support provided under this grant in Massachusetts for 2016 was $380 million to finance 25 new construction projects, 13 carryover projects, and 15 planning projects all across the state. Another fund provided by the EPA is the Drinking Water State Revolving Fund (DWSRF) for the construction of new water treatment facilities to ensure quality of drinking water. Depending on the construction design and capabilities, the POPP could also receive grant money under this program.

It is typical for most grant or other loan financing programs to require a percentage of personal investment as part of their acceptance process. As such, it is expected that at least 10-20% of the capital costs and other outlays would need to be sourced from the users of the POPP as well as the project sponsor. A portion of the financing and investment needs could be obtained from companies within the POPP network that would utilize the facilities for purposes of treating their wastewater. These companies already have costs associated with their current process and the purpose of implementing the POPP would be to decrease those costs, but not eliminate them entirely. For example, in a recent study, an average annual spend for these companies of $600k was reported to process an average daily flow of about 760k gallons/day (with a range of $1.23 to $3.42 per one thousand gallons processed).[39] Respondents also

[38] State Revolving Fund (2015). MassInc. http://www.mass.gov/eea/agencies/massdep/water/grants/state-revolving-fund.html (accessed on November 26th 2015).

[39] Survey Examines Wastewater Treatment Costs (2015). Industrial WaterWorld. http://www.waterworld.com/articles/iww/print/volume-11/issue-1/feature-editorial/survey-examines-wastewater-treatment-costs.html (accessed on November 27th 2015).

indicated that "they would be moderately or very interested in a new on-site system if it could reduce their costs by 40% on average."[40]

Given this information, a fee structure could be designed so that there would be an initial setup fee to connect to the POPP in year one, but then also an annual usage fee for each company within the network which would need to be below the current average annual spend. The fee structure would be negotiated separately with each firm based on the specific needs of that firm and if more specialized equipment would be needed to serve that customer they should be responsible for a portion of that additional cost to acquire such equipment and be included in the setup fee. Keeping in mind that the fee structure would have to incentivize companies to connect to the POPP facility, therefore the fee agreements would need to yield a cost-savings as compared to what the firms are already paying through their existing treatment process. A consultation with each company would need to occur and include an analysis of their current process and associated costs to determine an adequate fee structure relating to the POPP.

[40] Survey Examines Wastewater Treatment Costs (2015). Industrial WaterWorld. http://www.waterworld.com/articles/iww/print/volume-11/issue-1/feature-editorial/survey-examines-wastewater-treatment-costs.html (accessed on November 27th 2015).

FUTURE RESEARCH

Future research can examine electronic manufacturing companies like OnCore to bring new industries to Springfield, Massachusetts. OnCore Manufacturing, LLC is a "leading provider of product commercialization services for low-medium volume, high-complexity products to international blue-chip aerospace and defense, industrial, and medical companies."[41] OnCore has manufacturing plants all around the world, in Wilmington MA, Longmont, CO, San Marcos and Fremont, CA, China, Mexico, Tijuana, and Springfield MA.[42] While many companies are producing and manufacturing their products offshore, OnCore is a company that has one manufacture facility in Springfield and others across the United States.

Other companies to explore include NATEL Engineering Company since the company may soon merge with OnCore. The companies aim to bring high quality and reliability products to consumers around the world and plan to have new manufacture locations (13), new employees (3,750), and increased revenue ($770 million).[43] NATEL is recognized as being America's largest and most experienced private manufacturer of microelectronic, including large format lithium ion

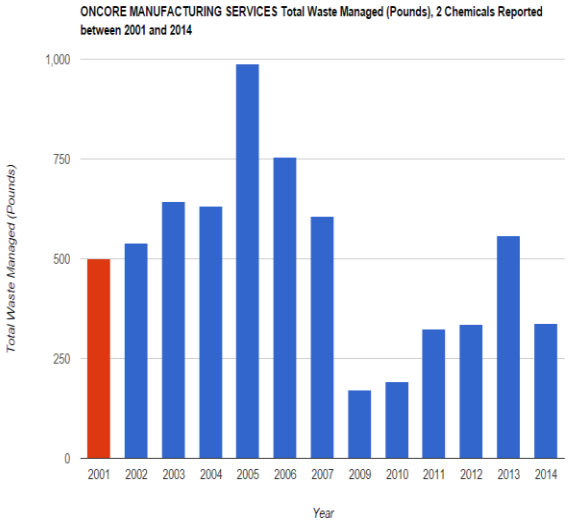

Figure 5: OnCore Total Waste (Lead, Lead Compounds)

[41] PR News Final. NATEL and OnCore Manufacturing Announce Merger Agreement (2015). http://www.prnewswire.com/news-releases/natel-and-oncore-manufacturing-announce-merger-agreement-300057571.html (Accessed on December 17th 2015)
[42] PR News Final. NATEL and OnCore Manufacturing Announce Merger Agreement (2015). http://www.prnewswire.com/news-releases/natel-and-oncore-manufacturing-announce-merger-agreement-300057571.html (Accessed on December 17th 2015).
[43] PR News Final. NATEL and OnCore Manufacturing Announce Merger Agreement (2015). http://www.prnewswire.com/news-releases/natel-and-oncore-manufacturing-announce-merger-agreement-300057571.html (Accessed on December 17th 2015).

for International Space Station. OnCore is recognized for its experience in engineering services. The soon-to-be merger will aim to deliver new engineering and manufacturing solutions to the Medical, Industrial, Aerospace and Defense markets.

Table 9: TRI Data on OnCore (2013), data reveals that OnCore is sending its waste management off-site. [44]

Reported TRI Chemical Data (in pounds, for all chemicals reported in 2013).	
Total On-Site Releases:	0
Total Off-Site Releases:	0
Total Transfers Off-site for Further Waste Management	558
Total Waste Managed	558

The POPP can help companies like OnCore and NATEL and encourage new electronic and high-tech manufacture companies to relocate to cities that have the POPP. For example, it is clear that OnCore is treating its wastewater off-site (table 9) and includes harmful chemicals like lead (figure 5). Therefore, instead of having the companies pay for the wastewater to be treated, the POPP can drastically alleviate the burden of treating wastewater. The solution can encourage businesses like OnCore to continue manufacturing in cities like Springfield and can motivate new companies to also re-locate to Springfield. Therefore, communicating with the manufacturing plant in Springfield, Massachusetts will be an important step moving forward.

[44] TRI Explorer. OnCore (2015). Environmental Protection Agency. http://oaspub.epa.gov/triexplorer/release_fac_profile?trilib=TRIQ1&FLD=&FLD=RELLBY&FLD=TSFDSP&OFFDISPD=&OTHDISPD=&ONDISPD=&OTHOFFD=&TRI=01104NVSNS225CA&year=2013 (Accessed December 18th 2015).

CONCLUSION

Famous economist and philosopher Amartya Sen says "the social multipliers [of employment] concern the benefits...of decreased crime, drugs, and family disruption, and increased and strengthened security, education, healthcare, and environmental protection."[45] Therefore, the true benefits of the POPP project will be numerous, as social multipliers will cause the benefits to ripple into a mutually reinforcing cycle in which the benefits in one area increase the benefits in others. Increased commercial and industrial activity can assist towns in collecting tax revenue to improve public services, such as education. The positive feedback loops will be plentiful, in economic, social and environmental reform.

Overall, the POPP is an innovative and helpful tool that will encourage businesses that generate toxic waste to discharge their wastewater into a centralized, well-designed treatment facility, a POPP. The POPP will be extremely advantageous to the businesses generating the wastewater as the POPP will drastically reduce the price of production. Additionally, the POPP will be beneficial to the community as a whole as it will generate more businesses to come to the region and manufacture their products. Employment will rise, helping the city of Springfield and the state of Massachusetts. The POPP will also be extremely valuable to residents in the area, as their local streams will be less polluted as companies will not be falsely discharging their untreated wastewater into rivers. Therefore, the POPP is an innovative social, economic, environmental solution to wastewater treatment.

[45] Forstater, M. (2015). Working for a better world Cataloging arguments for the right to employment. Philosophy & Social Criticism, 41: 61-67.

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