

**Water Conservation in Northfield:**  
**Water Rate System Revision and Sprinkling Restrictions**

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**I. EXECUTIVE SUMMARY**

Northfield is a small, attractive city of environmentally aware residents who are already making some changes in their own routines to conserve water. The city's progressive attitude towards sustainability is fundamental to introduce new policies concerning the conservation of the Jordan aquifer, which is in a dire situation. To ensure water availability and affordability in the long-term, the city needs to expand its policies to reduce the water demand. The policies with the most potential for impact would be raising the price, charging seasonally, increasing the price for lawn watering and applying sprinkling restrictions, as evidenced by other cities which adopted similar policies. These policies need to be accompanied by transitional measures by adding more tiers to the water rate system, and converting the units from cubic feet to gallons in order to foster more support and understanding of water conservation among residents. The goals of these policies are to assure social justice, economic opportunities and environmental protection. The implementation of these policies will not be a financial burden to the city because they do not require extra work human resources. Moreover, not applying these policies now will cost more in the future as the access to water becomes restricted and expensive.

**II. INTRODUCTION**

The city of Northfield, Minnesota, located mostly in Rice County, with a small proportion in Dakota County, depends for its water supply entirely on the Jordan aquifer.<sup>1</sup>

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<sup>1</sup> Water Division | Northfield, MN - Official Website." 2016 TH 246 and Jefferson Parkway Intersection Study | Northfield, MN - Official Website. Accessed May 29, 2018. <https://www.ci.northfield.mn.us/365/Water-Division>

However, as the most heavily used aquifer in the region, the Jordan Aquifer is facing the issue of over-pumping. The Jordan Aquifer is located under southeastern Minnesota, but also extends into the whole Iowa, parts of Wisconsin, Illinois, Indiana, and Michigan.<sup>2</sup> The problem is that the population and consumption in these states are rapidly increasing while the water supply is going in the opposite direction. Several areas of the aquifer in Minnesota have already approached an alarming limit.<sup>3</sup>

Northfield, home to over 20,000 residents and over 1500 business and 2 small-scale liberal arts colleges, needs a stable supply of water to ensure the growth of the community and maintain its attractiveness to faculty and students.<sup>4</sup> Water scarcity would pose significant restrictions on Northfield's economic development and community growth.

As a preemption to future water scarcity, Northfield needs to act along with other Minnesota cities to explore the possibilities of conserving water through policy change. Since people respond to financial incentives, reconstructing the water utility rate system by gently raising the price of water, charging differently by season, and raising the cost of lawn-watering could effectively influence the water consumption behavior of the residents. Moreover, the city would still be able to pass monetary savings on to the consumers. Dividing the current 4-tiers water rates into smaller tiers would also ensure that as the water price goes up, the water rate system could still provide affordable water use for everyone. Additionally, as an informational measure, adding the unit conversion from cubic feet to gallons will enhance understanding of water consumption and waste. Besides changing the utility rate system, changing the sprinkling

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<sup>2</sup> Thrive MSP. *2040 Water Resources Policy Plan*, May, 2015. Minneapolis: Metropolitan Council. <https://metro council.org/Water-Resources-Policy-Plan>

<sup>3</sup> Eller, Donnelle. "Growing Water Use Threatens to Strain Jordan Aquifer." *Des Moines Register*, November/December, 2014. <https://www.desmoinesregister.com/story/money/agriculture/2014/11/15/water-use-jordan-aquifer-restrictions/19040407/>

<sup>4</sup> Data Access and Dissemination Systems (DADS). "Community Facts." American FactFinder. October 05, 2010. Accessed May 29, 2018. [https://factfinder.census.gov/faces/nav/jsf/pages/community\\_facts.xhtml](https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml).

habits and promoting a scientific understanding of lawn cultivation is also greatly likely to make a difference. The odd-even day sprinkling would cut the number of sprinkling days in half, and the midday sprinkling ban, and the moisture sensor installation would ensure the efficient use of water. These two major policy recommendations, water billing revision and sprinkling restriction, are also complementary to each other if combined.

Following this introduction, this paper will first provide justification of the need for actions by discussing the water issue Northfield faces in environmental, social and economic contexts. This paper will elaborate on the water utility rate revision policy and the sprinkling restrictions described above respectively in part A and B of section IV. Furthermore, in section IV, this paper will survey the effectiveness and practicality of water rates policies and sprinkling restrictions employed by other municipalities, evaluating them based on the current situation of Northfield. In the concluding section, we will highlight the importance of addressing domestic water conservation in the context of Northfield's groundwater resources and its goal to develop sustainably.

### III. ENVIRONMENTAL, SOCIAL, ECONOMIC RISKS

Groundwater makes up about 22 percent of all the commercial and domestic water use in the United States.<sup>5</sup> Minnesota is a great example of heavy regional reliance on groundwater because of the state's access to the Jordan Aquifer. According to the 2010 USGS National Water Information System data, about 3 out of the 5.3 million population in Minnesota obtained their domestic water from groundwater.<sup>6</sup> In a number of Minnesota counties, the proportion of people relying on groundwater is staggering. While Dakota County, the third largest in the state, relies

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<sup>5</sup> Howard Perlman, "Groundwater Use in the United States," The USGS Water Science School, accessed December 20, 2017. <https://water.usgs.gov/edu/wugw.html>

<sup>6</sup> "The Condition of Minnesota's Groundwater 2007-2011," Minnesota Pollution Control Agency, published August, 2013: 9.

85% on groundwater, Rice County, which includes most of Northfield, relies 100% on groundwater. Both counties supply the city's needs and pump water from the same local aquifer. Thus, the city is responsible for four wells that draw groundwater from the Jordan aquifer.

Currently, the Jordan aquifer is the most heavily used in the region. In 1977, Bob Libra, state geologist of Iowa, stipulated that the reservoir level of the Jordan aquifer could not go down 200 feet without representing a "threat to the public interest in the availability of water for sustained beneficial use of the aquifer."<sup>7</sup> The unsustainable pumping practice in Minnesota is leading to the depletion of groundwater far faster than it can recharge. The state of 10,000 lakes is often thought of as water rich, but some of its lakes fed by the Jordan aquifer systems are shrinking as evidence of groundwater depletion. White Bear Lake, for example, experienced a dramatic decline in recent years. According to Minnesota DNR, the usual high water mark of 924.9' feet in the lake has been steadily dropping since 2003, and reached a record low of 919.33' feet in 2010.<sup>9</sup> Furthermore, the geologic structure and components of the aquifer make it more vulnerable to nitrate, chloride, iron and manganese contaminations related to the gravel aquifer's land use and depth. According to the Minnesota Pollution Control Agency, "(t)he highest nitrate concentrations observed in this investigation typically were in the shallow groundwater underlying agricultural lands," which means that the exposure to contaminants increases as the level of water decreases.<sup>10</sup> The sobering truth learned from this threatening experience is that, in spite of apparent water abundance, the groundwater and lakes are not

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<sup>7</sup>Bob Libra, "Iowa's Jordan Aquifer: Current Status and Future Conditions", 25. [www.iowadnr.gov/Portals/idnr/uploads/water/wse/jordan\\_aquifer.pdf](http://www.iowadnr.gov/Portals/idnr/uploads/water/wse/jordan_aquifer.pdf)

<sup>8</sup> Iowa Adm. Code 567 Chapter 52.4(4)c. (1971) <https://www.legis.iowa.gov/docs/iac/chapter/567.41.pdf>

<sup>9</sup>John Brewer, "White Bear Lake Is Shrinking - \$200,000 Study Would Examine Why." Twin Cities, last modified November 12, 2015, <https://www.twincities.com/2011/01/29/white-bear-lake-is-shrinking-200000-study-would-examine-why/>.

<sup>10</sup> "The Condition of Minnesota's Groundwater 2007-2011," Minnesota Pollution Control Agency, published August, 2013: 2.

unlimited resources. The shrinking and contamination of the Jordan aquifer raises a chain of management concerns.

This environmental threat will also strongly impact the Northfield community. According to the city's Wellhead Protection report, "(t)he population of Northfield is likely to continue rising and the demand for public water is expected to increase approximately 1.7% per year over the next five years."<sup>11</sup> Thus, two main problems might arise from water scarcity: an abrupt and large increase in price will impact all residents' budgets and clean water will become restricted to wealthier neighborhoods. Cases of environmental injustice are common throughout the whole country, in which water and other resources become barely affordable or the water available is contaminated, while clean bottled water is not equally distributed. This situation is still avoidable in Northfield if actions are taken as early as possible to mitigate environmental and social threats.

Another consequence of the Jordan Aquifer's depletion is the impact it might have on the economy of Minnesota cities, especially Northfield. The yearly cost of living in Rice County is approximately \$53,785 which is already high compared to other counties.<sup>12</sup> As the population continuously increases in Northfield, a high jump in the price of water will make living costs unaffordable in the city. Thus, current residents might have to move away and prospective residents will be difficult to attract. At the business level, companies like Malt-o-Meal and farmers might also be repelled as the cost of water for production and maintenance becomes unprofitable unless the price of their products rises as well, which is unsustainable in a small community like Northfield. Therefore, Northfield's economy will be seriously affected if resources become scarce and expensive.

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<sup>11</sup> Bolton & Menk, Inc., "Amended Wellhead Protection Plan, April 2012," Northfield, MN, Project No. T15.102880 published May, 2012: 7. [www.ci.northfield.mn.us/](http://www.ci.northfield.mn.us/)

<sup>12</sup> "Cost of Living in Minnesota", Minnesota DEED, Labor Market Information, 2018, [mn.gov/deed/data/data-tools/col/](http://mn.gov/deed/data/data-tools/col/)

On the other hand, Northfield has already begun to do a very good job in decreasing its water consumption levels over the past few years. The city daily per capita demand was 55.69 gallons in 2006 and 45.12 gallons in 2015.<sup>13</sup> Most of this decrease is the result of behavioral changes as the residents adapted their customs according to the recommendations the city provides. For a more effective impact, however, these changes need to reflect more rigorous policies, which would not only help Northfield but also influence other Minnesota cities to implement their own policies. Thus, the fact that Northfield residents have already begun to conserve their water opens several opportunities for the city to become a role model to the entire state. If Northfield takes up its responsibility for the conservation of the aquifer with legislative enforcement, and other cities start to do the same, we will be able to keep the aquifer's water level above the limit of 200 feet and maintain healthy water in Minnesota. As a consequence of these new policies, Northfield residents, who are already accountable for important changes, will develop more agency over their own expenses by being given the option of saving money as they reduce their consumption. This reduction will also contribute to the equal availability of water in the future. Finally, the integrity of Northfield's community will be a key factor to self-sustenance as the businesses and farmers make profits and supply the residents with their products at reasonable prices. Given these opportunities, Northfield should accelerate the water conservation process and ward off any social and economic risks subsequent to this environmental threat by implementing price and restriction policies.

### III. POLICY PROPOSALS AND OPPORTUNITIES

#### A. Water Rate System

Northfield residents do a very good job using the city's natural resources thoughtfully. However, there are still aspects of the city's policies that can be improved to further decrease

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<sup>13</sup>Justin Wagner, Northfield City Utilities Manager, email message to author, date.

Northfield's demand and prevent wasteful behavior. Although the current water system assures water distribution and affordability for everyone, it does not account for the depletion of the resource. In order to mitigate this natural threat, four main aspects of the water rate system should be revised: first, the price of water in Northfield is considered to be extremely low compared to its neighbor cities. Keeping the price low now will result in an abrupt rise of cost in the future when the aquifer is no longer able to supply the needs of all the communities. Second, Northfield and many other Minnesota cities where the four seasons are very distinct disregard the climatic influence on demand levels, instead of charging according to the seasons' demands. Third, the residents cannot manage what they cannot measure. Utilities customers are less familiar with the units currently used for billing, which makes it more difficult to distinguish wasteful usage from basic consumption. Finally, regarding the problem with lawn water further discussed in the section on sprinkling restrictions, the current outdoor water billing system presents a disincentive to water conservation. Therefore, this section will discuss how the water rate system should be revised in Northfield to limit residents' consumption, while at the same time preserving their access to affordable water and providing more information on water conservation.

#### 1. Increase Water Price & Create More Tiers

Although raising the price of any resource is usually an undesirable decision, three factors need to be pointed out: (1) the current price of water supply does not reflect the urgent situation of the Jordan aquifer, (2) as a countermeasure, more billing tiers must be included allowing residents to avoid being aggressively affected by the price raise, (3) the application of price raise and addition of billing tiers will not require extra work or additional employees.

The current water bill in Northfield is not expensive. According to the city's website, Northfield's rate includes the water meter base cost per month (\$7.00) and has four different billing tiers. These tiers change according to the type of facility using the water, but for the purpose of this article, we will mainly discuss the single-family residential tiers. As shown in Table 1, each tier has a determined price which is accumulated every 100 cubic feet (CCF) of water. In other words, the price in each tier increases linearly as the consumption rises.<sup>14</sup> Considering that in 2015 Northfield's daily consumption per capita was approximately 180 cubic feet (45.12 gallons), which is already a low level of consumption, and the low average residential price, it is difficult to make water or money economies.<sup>15</sup>

## Utility Rates

### Water - Single Family Residential

Service	2018 Rate	2017 Rate
Meter Base Charge	\$7.00 Flat base per month	\$7.00 Flat base per month
Tier I - 1 to 500 cubic feet	\$1.18 per 100 cubic feet	\$1.18 per 100 cubic feet
Tier II - 501 to 1,000 cubic feet	\$1.42 per 100 cubic feet	\$1.42 per 100 cubic feet
Tier III - 1,001 to 2,000 cubic feet	\$1.78 per 100 cubic feet	\$1.78 per 100 cubic feet
Tier IV -Over 2,001 cubic feet	\$2.23 per 100 cubic feet	\$2.23 per 100 cubic feet

**Table 1: Utility rates<sup>16</sup>**

The increase of price alone could have the same aggressive economic impact the scarcity of water will otherwise have in the future. However, with the addition of more tiers in the water rate, the impact of the increase in price could be mitigated. If applied along more tiers of consumption, Northfield's rise in water price would induce the residents to economize by reducing their water consumption to a lower-priced tier. These new, smaller tiers are

<sup>14</sup>“Utility Rates,” City of Northfield, MN - Official Website, accessed May, 2018.

<https://www.ci.northfield.mn.us/524/Utility-Rates>.

<sup>15</sup> Justin Wagner, Northfield City Utilities Manager, email message to author, May 17, 2018.

<sup>16</sup> “Utility Rates,” City of Northfield, MN - Official Website.



complementary to the price rise because the goal is not to overtax water, but to reduce water waste. If Northfield shortens the first tier to 1-300 cubic feet, for example, and maintains the current price for this tier, while the second tier is also shortened but has its price raised, as shown in table 2, residents would likely prefer to stay within the first tier, and consequently make individual efforts to reduce their consumption. These individual goals to save money and water can easily be set because Northfield installed automatic meters in 2011, and these help to track precisely how much water is used.

Current		Proposal	
I Tier (1-500 cubic ft)	\$1.18 (per CCF)	I Tier (1-300 cubic ft)	\$1.18 (per CCF)
II Tier (501-1000)	\$1.42 (per CCF)	II Tier (301-500)	\$2.00 (per CCF)

**Table 2: an example of water price raise in Northfield**

As mentioned in the previous paragraphs, Northfield has been preparing the way for some sustainable reforms and it has become a forerunner in the water conservation process. The recent installations in Northfield give us more opportunities to make adjustments in the water bill system. According to the municipality's website,

The City of Northfield completed installation of a citywide automated water meter reading (AMR) system in 2011. Designed to last many years, the AMR system benefits customers and city operations alike. Customer service levels have improved through this automated system of obtaining meter readings due to timely and accurate reporting of water usage each month. Efficiencies were gained since city staff does not have to manually enter individual meter readings into the monthly bills.<sup>17</sup>

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<sup>17</sup>"Water Meter Information," City of Northfield, MN - Official Website.

These new water meters are helpful in making changes to water billing because they record precisely the amount of water being used. This upgraded billing system has been running since 2011 and, as mentioned above, no extra manual work will be required to use the numbers displayed on the residential meters in smaller billing tiers.

Furthermore, Northfield currently has a water billing system adaptable to more sustainable policies due to its complexity: the city is one of few which charges not only by meter size but also by range-of-use tiers. However, as shown in table 3, compared to other cities in Minnesota where water is also charged by meter and tier, the price for water in Northfield is much lower and the range of the tiers in other cities is wider. Some of these cities measure their tiers according to average use. According to the Environmental Protection Agency's (EPA) website, "(t)he average American uses around 88 gallons (11.76 cubic feet) per day per person in the household. That means a family of four would use around 10,500 gallons (1403.6 cubic feet) in a 30-day period." This estimation is used by Saint Peter, MN, in the city's water use tiers: the first tier is up to 10,000 gallons (1336.8 cubic feet) and the second contains anything above that amount.<sup>18</sup> Duluth, MN, which has part of its water supplied by groundwater and the other part by Lake Superior, has adopted a different strategy: charging by common use, which means, the most popular tier is the most expensive.<sup>19</sup>

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<sup>18</sup> "Water and Sewer Rates and Charges," City of Phoenix, accessed May, 2018.  
<https://www.phoenix.gov/waterservices/customerservices/rateinfo>.

<sup>19</sup> "Rate Sheet." ComfortSystems - Duluth, MN, accessed May 11, 2018.  
<http://www.comfortsystemsduluth.com/media/543160/rate-card-revised-1-1-18.pdf>

Tier (CCF)	Northfield	St. Peter	Duluth	Northfield	St. Peter	Duluth
Meter	-----	-----	-----	\$7	\$16.24	\$10.94
I	1-500 (3,740 gallons)	0-1,337 (10,000 gallons)	0-3,200 (23,937 gallons)	\$1.18 (per CCF)	\$6.80 (per 133 c.f.)	\$3.67
II	501-1000	Over 10,000 gallons	3,2-8,000 (59,844 gallons)	\$1.42	\$7.10 (1,000 gallons)	\$3.44
III	1001-2000	-----	8-24,000 (179,532 gallons)	\$1.78	-----	\$3.03
IV	Over 2000	-----	Over 24,000	\$2.23	-----	\$2.66

**Table 3: Northfield, Saint Peter, and Duluth's water rates**

Therefore, instead of waiting until the aquifer's water becomes inaccessible, and then abruptly raising Northfield's water cost, Northfield should adopt a strategy for water conservation now. The most efficient option for Northfield, given how low its rates are currently, compared to the other cities, is to raise the price of water. However, given the current status of Northfield moving forward into sustainability and the already low average water use, this measure should not come as a penalty to Northfield residents. Thus, to make this transition smoother, the division of the current billing tiers into smaller ones will discourage wasteful use of water and will keep one low-priced option in place so that low-income people have a way to avoid the higher charges. As a result, the residents will become more aware of their own consumption and set individual goals to save money, and consequently promote water conservation. Ultimately, these changes need to be complementary in order to reach water conservation goals and awareness in Northfield, assuring more thoughtful use of water and preserving the accessibility of the resource to everyone.

## 2. Charge by Season

Another improvement to the water billing system in Northfield that could be implemented is seasonal pricing. Other cities outside the state of Minnesota are adopting

different rates for summer (high season), winter (low season), and the seasons in between (medium seasons). This measure also contributes to the balance of water billing, and to the fairness of the prices, lowering charges in seasons when the residents' demands are reduced.

While Northfield offers a discount for lawn and pool water (summer watering), other municipalities have different rates according to the season's demand. A very good example of this implementation is illustrated by the city of Phoenix, Arizona, in 2017. The city's water rate is charged by seasonal volume, in which December to March is considered the Low season, April, May, October and November are considered the Medium season, and June to September the High season. These labels refer to both demand and cost level; i.e., High season implies higher demands and more expensive charges while Low season refers to low demands and cheaper charges.

Yet, cities in Minnesota do not invest as much in seasonal pricing as they should being part of a state which has all four distinctive seasons. In Saint Paul, for instance, there is a small transition to seasonal pricing, charging additional 0.10 cents per unit during the Summer, while many other cities completely disregard seasonal demands in its charges. Rochester's water rate exemplifies this: "for the first three months of the year, your waste water charge is determined by the actual units of water used. Your base charge for April – December is determined by your average water usage during the months of January, February, and March. You will be charged this same "base" rate throughout the year regardless of summer watering."<sup>20</sup>

If Northfield changes its water rate by charging according to the intensity of the season's demand, residents will pay fairly for what they use. Charging more for water when the demand for the resource is higher is the most efficient way to prevent waste. At the same time, by being

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<sup>20</sup> "RPU Rates & Fees," Rochester Public Utility - We Pledge, We Deliver, accessed May, 2018. <https://www.rpu.org/my-account/rates-fees.php>

charged according to the seasonal demand level, residents should be able to pay less for seasons in which the demand is lower. If this proposal is adopted, it will not only put the city in a more sustainable and rationalized direction but will also induce other cities in the state to adopt similar measures.

### 3. Using the bill for information

Northfield already uses paper bills for important announcements about water resources and billing information; these appear at the bottom of the utility bill. To make bills more informative for customers in terms of water consumption and waste awareness, Northfield should include the unit conversion from cubic feet to gallons. If the residents recognize the units of measurement, it is easier for them to understand how much water is typically used and being wasted. This familiarity with the units will enable customers to interpret their own usage, set goals to reduce waste, and consequently promote a more rational use of water. Having a more aware community is a fundamental prerequisite to achieve conservation of natural resources.

The standard unit for water bills is a hundred cubic feet (CCF). This unit might be convenient for water meters and overall city consumption surveys, but it is not the best choice for water bills once the goal is to make residents more conscious about their waste. Saint Peter adopted gallons for establishing the billing tier range, for outdoor water charges, and even for other utility services, such as refuse. In Northfield's case, however, instead of proposing the replacement of the water units, the addition of the conversion from CCF to gallons should be included in the utility bills. The conversion information will function as an educational tool for residents to become more familiar with CCF, which is still used in other publications they might access. Since Northfield already uses paper bills to inform residents about utilities, there is already an opportunity to improve these forms of outreach to publicize important announcements

and recommendations about water conservation. Additionally, many consumers use online platforms to pay their bills; therefore, all of the same information should also be offered virtually. This way customers would have a better idea of how much water they consume using their perception of gallons, and they would also be able to better understand the amount in cubic feet, which is still a conventional unit used in many other contexts.

#### 4. Increase Cost of Lawn Watering

Currently in Northfield, lawn water and domestic water are charged separately, so that the sewer service or sanitary fee can be discounted from the rate charged for lawn and pool water. In other words, Northfield allows its residents to have a second water meter that only meters water used for outdoor watering, irrigation, pool fills or other uses that do not return water to the city's wastewater system for treatment and disposal. The discount from the absent sanitary fee motivates people to use more outdoor water for which they pay less.

The existence of separate meters for indoor and outdoor water use is not the aspect we propose to change; the issue we point out in this section is the low charge for lawn water, which is a counter-incentive for water conservation. We propose that indoor/outdoor water bills remain separated, but an extra "environmental fee" would be applied to outdoor watering, similar to the sanitary fee included with indoor watering. (These fees should still be included separately on the bill, for purpose of water consumption and waste awareness). Since wastewater billing is based on the amount of water passing through the primary service meter only, and not charged from the lawn meter, this additional tax would just act as a discouragement for wasteful use of water for lawns and pools. Besides, the money obtained from these taxes could be used for grants to sponsor the installation and maintenance of rain gardens and rain barrels, for example, offered to residents by the government programs.

With respect to this specific water waste concern, Northfield's official website has a section on water conservation about recommendations for watering lawns. The existence of such informational material illustrates that Northfield already has some awareness of the importance of water conservation in connection with lawn watering. However, only recommending people to adopt conserving behaviors will not do enough. For this reason, the additional “environmental fee” for outdoor watering should be considered for further water conservation promotion. More practical outdoor water conservation requirements will be discussed in the sprinkling restrictions section from the analysis of Northfield and EPA’s recommendations.

The idea of having an additional “environmental fee” comes from a comparison with what other municipalities are doing concerning lawn water bills. Although Phoenix, Arizona, does not have a separate bill for indoor and outdoor water, for all water usage the city applies “Environmental Charges” of \$0.28 on each unit (CCF). This additional fee was adopted in 2017 “as part of the cost to implement unfunded regulations created by the U.S. Environmental Protection Agency, the Arizona Department of Environmental Quality, or the Maricopa County Department of Environmental Services.”<sup>21</sup>

In Saint Peter, on the other hand, the bills are separate, but the price for residential irrigation water is higher per 1,000 gallons than charged for indoor water. While the commodity charge is up to \$7.10 (second tier) per 1,000 gallons for indoor water, there is a fixed charge for outdoor water of \$7.25 accumulated every 1,000 gallons.<sup>22</sup> Therefore, Saint Peter's residents have separated bills for indoor and outdoor water, but still, they pay more for the outdoor usage.

In this context, our proposal for Northfield is to charge more for outdoor water by including an environmental fee. Instead of discounting service fees for lawn water, which is a

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<sup>21</sup> "Water and Sewer Rates and Charges," City of Phoenix.

<sup>22</sup> "Residential Utility Rates," City of Saint Peter, Minnesota, accessed May 2018.  
<http://www.saintpetermn.gov/residential-utility-rates>

disincentive to water conservation, an environmental fee should be added. This policy would assure control over outdoor water demand and that the taxes collected will be used for environmental purposes, such as supporting residents who are interested in investing in water conservation through initiatives like rain-barrels and rain-gardens.

## B. Sprinkling Restrictions

The sprinkling restrictions involve odd-even day sprinkling, midday sprinkling ban, moisture detector installation, and fines for non-compliance. This policy will reduce the water people use outdoors by up to 15 percent, provide healthier lawns to homeowners, generate revenue for the city and will also be inexpensive to implement.

### 1. Current Situation in Northfield

Sprinkling restrictions that mandate residents to sprinkle efficiently, scientifically, and economically do not yet exist in Northfield but are widely practiced in many Minnesota municipalities. Horticulturalists suggest that daily watering of lawns and gardens will create an unhealthy conditions for the lawn since a healthy lawn only requires one inch of watering each week, a level residents could easily achieve by watering every other day.<sup>23</sup> On the other hand, over-watered lawns are less healthy because they cannot generate deep roots.<sup>24</sup> However, according to Jayne Hager Dee, Representative of the 5th electoral district of Dakota County, Board member, treasurer of Dakota County Water and Soil Conservation, it is a reality that many Northfield consumers sprinkle every day and even on days when it is raining, creating an unnecessary waste of water even when the gardens and lawns already received enough moisture.<sup>25</sup> Some sprinklers go off in the middle of the day when both the temperature and the

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<sup>23</sup> "Watering Correctly Saves Time, Money, And Plants." *Great Plant Escape* - Flower Parts. Accessed May 29, 2018. <https://extension.illinois.edu/hortihints/0108a.html>

<sup>24</sup> "Watering Correctly Saves Time, Money, And Plants." *Great Plant Escape* - Flower Parts.

<sup>25</sup> Jayne Hager Dee, Personal communications



rate of evaporation are at its highest. This is either because people lack knowledge about the scientific ways to sprinkle or because people who do have the knowledge do not feel motivated to adjust their sprinkling schedule or manually cancel sprinkling after rain.

Northfield policymakers do recognize the importance of sprinkling scientifically and have made efforts to promote more economic sprinkling habits. Good intentioned as their measures are, the effects are limited and have shown that Northfield has not explored the possibilities through policy change enough. In 2005, the city created an educational pamphlet to inform people about the science of lawn watering.<sup>26</sup> The electronic version can be accessed through the Northfield city website with a link to “Lawn Watering: A Series of Water Quality Fact Sheets for Residential Areas”. Three out of six pages of the document are justifying the case to not over-water. However, it is questionable whether the presentation of this information is an effective way to reach the Northfield population. Reasonably, residents who would spend their personal time locating this pamphlet on the city website and reading it are the more environmentally aware group of the community. They are the group who are likely to change their behavior once they are shown the necessity; therefore, it remains a problem for information and incentives to reach the less environmentally aware population.

The low water price also has a negative effect on creating motivation for residents to change their watering habits. As mentioned in the previous part of the essay, Northfield allows each household to have an outdoor water use meter besides the regular indoor meter. Since outdoor water use does not go through the sewage system like indoor water use does, the price for water used outdoors is about  $\frac{1}{5}$  of water used indoors. Thus, it is tempting to be wasteful on outdoor water use. The lack of restrictions also fails to provide an incentive for people to look at

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<sup>26</sup> Korb, Gary, and UW-Extension. *Lawn Watering*. PDF. Madison: University of Wisconsin–Extension and Wisconsin Department of Natural Resources, 1999.  
<https://www.ci.northfield.mn.us/DocumentCenter/View/1347/Lawn-Watering-Document>

plant alternatives and various types of water conservation programs available in Northfield. For example, people are not incentivized to look at native plant species that require less water.

If sprinkling practices were run on a scientific schedule, Northfield residents would be able to conserve up to 15 percent of their current water use . According to EPA data, in American households, 30 percent of the water used domestically goes to outdoor water use.<sup>27</sup> As the EPA suggests, homes with sprinkling systems that sprinkle everyday regardless of the weather consume 50 percent more water outdoors than homes that adjust their sprinklers manually.<sup>28</sup>

## 2. What other municipalities are doing

Though not a current policy in Northfield, sprinkling restrictions are very common in many other Minnesota and US municipalities to make sure people conserve water in their backyards. Minnesota cities such as Burnsville, Blaine, the City of Prior Lake, Champlin, Chanhassen, Lakeville, Monticello are all current practitioners of sprinkling restrictions. Sprinkling restrictions in many of these cities already contain a systematic mandatory policy which includes seasonal or non-seasonal midday watering ban, odd-even day sprinkling, semi-mandatory water sensor installation and violation fines.

The midday watering ban forbids lawn and garden sprinkling in certain time periods, usually from 10 to 11 am in the morning to 3 to 5 pm in the afternoon. This policy aims at eliminating the behavior described above that leads to sprinkling during the warmest time of the day. The city of Burnsville justified this policy as the city “being a good steward of our natural resources, . . . (and) more efficient use of the area’s limited groundwater resources.”<sup>29</sup> The

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<sup>27</sup> "WaterSense." EPA. April 23, 2018. Accessed May 28, 2018. <https://www.epa.gov/watersense>.

<sup>28</sup> "Watering Tips." EPA. May 13, 2018. Accessed May 28, 2018. <https://www.epa.gov/watersense/watering-tips>.

<sup>29</sup> "Watering Restrictions." Burnsville, MN - Official Website - Protecting Ponds & Lakes. Accessed May 29, 2018. <http://www.ci.burnsville.mn.us/index.aspx?NID=553>.

midday watering is a widely used component in sprinkling restrictions of all the cities mentioned in this paper.

Similarly, as common as the midday watering ban is the odd-even day sprinkling policy that cuts in half the number of days on which each household is allowed to sprinkle. Odd-even sprinkling policy requires that homeowners with odd house address numbers sprinkle on the odd days of the calendar and homeowners with even numbers sprinkle on the even days of the calendar. Note that if there are 31 days in the month, homeowners with both even and odd house addresses can sprinkle on that day. However, there are also practical adjustments. For example, exemptions are available for newly seeded or sodded lawns and gardens within the first 30 days provided the homeowner completes a sprinkling permit form. In Burnsville, it is possible to apply for such an exemption with the completion of a sprinkling restrictions exemption request form, which can be downloaded from the city utility service website.

Fines are an unpleasant but helpful way to make sure residents comply with the restrictions. In different cities, penalties vary when a resident violates the sprinkling restrictions. In Monticello, MN, a resident will receive a written warning for a first-time offense, a \$25 fine for the second time, and a \$50 fine for three or more violations. The fifth or more offense fines reach \$200 for Lakeville and \$250 for Burnsville.

Beyond the midday sprinkling ban and the odd-even day sprinkling policies that are easy to implement, some cities even take their measures to a more intense level. In the city of Prior Lake, all newly-installed sprinkling systems are required to install rain sensors to save water when there's enough moisture in the soil. In Monticello, rain sensors are required on all newly-installed residential sprinkling systems, and are required on all commercial, institutional, governmental sprinkling systems. The rain sensor, also known as moisture sensor, cancels the

sprinkling when it detects enough moisture in the soil from precipitation or from past sprinkling. The device costs under 100 dollars. According to the website of the city of Prior Lake, a rain sensor will save at least 1225 gallons (163.76 cubic feet) of water per household on every rainy day.<sup>30</sup> The significant amount of water it can help to save could provide easy payback for people's initial investment in the device.

### 3. Proposed Change

As a growing community that relies completely on the limited groundwater resource of Jordan aquifer, Northfield needs to establish its overdue sprinkling restrictions system, following the examples of its municipal counterparts in the state. Northfield can start with initiating the more basic measures such as a midday sprinkling ban, odd-even days sprinkling and a fines system. As an even more progressive step, Northfield should consider mandatory installation of moisture/rain detectors in all newly-constructed sprinkling systems. Like other municipalities do, Northfield should also make sure exemptions are accessible to homeowners to newly seeded or sodded lawns provided they report to the city through a sprinkling permit form. Doing so will make the sprinkling restrictions reasonable and easy for residence to comply with. Sprinkling restrictions should also apply to industrial and commercial property in Northfield, including Carleton College and St. Olaf College.

In order to help the residents adjust to this transition, the city could also consider forming an implementation team in the early establishment period of Northfield's sprinkling restrictions. The team will work on ensuring every household resets its sprinkling system on an odd-even day basis and sprinkle only outside of the ban time. If Northfield does this, it would not have to actually supervise the sprinkling practices of every Northfield household in the long run, a

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<sup>30</sup> "Sprinkling Restrictions." Sprinkling Restrictions : Water Restrictions : City of Prior Lake. Accessed May 29, 2018. <http://www.cityofpriorlake.com/sprinkling-restrictions.php>

process that might take too much money and demand too many human resources of the government. Therefore, having an implementation team would be an effective alternative because members of the city government could conduct visits to make sure households change their sprinkling system default and convince them of the importance of doing so. Burnsville, Dakota county, a city with a population that is three times higher than Northfield's, has had effective sprinkling restrictions since 2012.<sup>31</sup> Considering the success in Burnsville, Northfield should also be confident in its ability to help its residents go through this transition. Sending out promotional information through public media could be a useful way to reach people. Making sure people are aware of the violation fines in the sprinkling policy would help increase the residents' willingness to cooperate. If Northfield could provide a convincing case for residents to adopt the change in advance, checking in with a household would take less effort and time for the implementation team. The amount of initial work is not only far from insurmountable, but it would also save supervision costs for the future. The current cost to carry out this plan is definitely cheaper compared to the impacts a depleted aquifer might pose on the community. A change at the current point is minimal compared to the significant problems for Northfield's economic development if water scarcity is allowed to escalate.

#### 4. Potential Opportunities

As mentioned in part 1, this paper concluded using EPA data that sprinkling restrictions could help residents save up to 15 percent of their current water bill. A typical American family uses 320 gallons of water daily, and a 15 percent usage reduction means 48 gallons of water could be saved. Other than taking 5 to 10 minutes to reset their sprinkling system, residents do not sacrifice their interests at all but are actually able to produce healthier lawns and save on

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<sup>31</sup> "Burnsville Watering Restrictions in Effect," Sun Thisweek, July 25, 2012.  
[https://www.hometownsource.com/sun\\_thisweek/burnsville-watering-restrictions-in-effect/article\\_55ee310e-0059-5b15-8b20-e825279b9b59.html](https://www.hometownsource.com/sun_thisweek/burnsville-watering-restrictions-in-effect/article_55ee310e-0059-5b15-8b20-e825279b9b59.html)

their water bills. The violation fine will also increase the revenue of the city, as a compensation for the cost of initial planning, supervision, and follow-up management.

The sprinkling restriction would also go hand in hand with our proposed policy in part 1 of increasing the cost for lawn watering. As mentioned, currently Northfield charges only \$1.18 for every 100 cubic feet of water used outdoors, including sprinkling but \$5.69 for indoor usage.<sup>32</sup> When the city places an environmental charge on lawn watering, there will be a strong financial incentive for people to reduce lawn watering, making it easier for the city to carry out the sprinkling policy.

Northfield is an environmentally minded city and is home to two renowned liberal arts institutions. It currently runs numerous water protection programs such as rain garden, rain barrel, and native planting etc. It is important not to forget that actions that require no installations or construction such as domestic water conservation, could be just as effective as any other program in water conservation. The fact that many cities in Minnesota are implementing sprinkling restrictions also emphasizes why it is important for Northfield to take up its share of responsibility in reducing human impact on the Jordan Aquifer. The actions today are worthwhile because they serve as preemptions of the economic restrictions and social problems that water scarcity is certain to bring about, as described in section II.

## V. CONCLUSION:

The sustainable development goal of Northfield for 2018 is stated on the city's website as: "The two main areas of water conservation that concern the city are protecting our natural

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<sup>32</sup> "Utility Rates," City of Northfield, MN - Official Website.

resources and passing on monetary savings to the consumer.<sup>33</sup>” This statement reflects that Northfield’s vision for sustainability is to have economic development and environmental quality as equally important goals. Given the alarming situation of the Jordan aquifer, there is a third goal to be achieved: the assurance of water resources for the present and future generations. The maintenance of current unsustainable water consumption behavior will restrict Northfield’s economic and social development as water becomes scarce and therefore inaccessible. Thus, immediate governmental action must take place through policy-making and policy implementation in water conservation. In this context, the most efficient way to reduce demand is through a revision of the water pricing system and restrictions.

The first step for an efficient reduction of water demand is reforming the water billing system. Four main changes must be done in this system in order to accomplish water conservation. First, water rates in Northfield should be raised given the situation of the city’s water source. However, proposing an abrupt raise of price is not fair to the residents and does not guarantee everyone’s right to basic needs access. For this reason, the addition of more tiers is a complementary policy to price raising in Northfield. Secondly, an additional fee should be included in lawn water bill to prevent water waste. Furthermore, the levies would be directed to environmental incentives, such as governmental sponsorship for environmental projects.

Moreover, since the demand for outdoor water increases according to the seasons, the third necessary modification is to become a seasonal billing system rating as High, Medium, and Low seasons. This policy assures balance and fairness of billing water, prevents water waste, and would serve as an example for other municipalities in the state which has not yet adopted a seasonal system. Finally, the fourth essential change for the effectiveness of this new system in

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<sup>33</sup> “Water Conservation,” City of Northfield, MN - Official Website.

reducing water waste and promote sustainable development is to foster an informed community by adding the conversion from the meter unit (CCF) to gallons.

Northfield also needs to take its current endeavor of promoting lawn watering conservation to regulating watering behavior with sprinkling policy. The benefits of establishing a sprinkling restriction will produce savings for people's water bill, conserve water, produce healthier lawns and generate more revenue for the city. In the meantime, human and financial resources Northfield needs to invest would only be marginal and could be paid off through the fine collection. Northfield should also realize that it is fully capable of implementing its sprinkling restriction from the fact that larger cities like Burnsville had accomplished the transformation.

As presented in this paper, Northfield is not yet a role model in the path for sustainable development, but the city has obtained an aspiration to improve in this direction. Nevertheless, these proposals are necessary to accelerate this process and to ensure the conservation of water and its accessibility to all residents. If the results show short-term efficiency, Northfield officers should keep these policies and restrictions at long-term for rational use of the natural resources.



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