An Analysis of Trends in U.S. Stormwater Utility & Fee Systems

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ABSTRACT

Many municipalities have established stormwater user fees (SUFs), commonly known as stormwater utilities, to raise revenue for stormwater management programs, however little is known about the trends among the fees currently in existence. This research observes trends in the establishment, type and magnitude of user fees by analyzing location, population density, home value, and establishment for a comprehensive national stormwater user fee database with data for 1,490 user fees. The Equivalent Residential Unit (ERU), a SUF that charges based on impervious area, was the most prevalent fee type in all NOAA Climate regions of the U.S. except the West and West North Central. The Tier system, a SUF that charges differently for properties by defined categories, was the second most prevalent in all regions except the East North Central and West North Central. The ERU was found in larger cities with high population densities whereas flat fees, SUFs that charge a single rate for all properties, were found in smaller towns. Higher home values led to higher monthly fees for 28% of the municipalities analyzed. The Residential Equivalence Factor (REF), a SUF that charges based on runoff produced, was popular in municipalities with higher home values and the flat fee was popular in those with lower home values. The number of SUFs established increased near Phase I MS4 permit and Phase II small MS4 permit deadlines.

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Table of Contents

List of Figures

List of Tables

List of Equations

1 Introduction

1.1 Background

In response to the urban stormwater problem (NRC 2009), legislation was passed to require control of stormwater quantity and quality from developed areas across the U.S. In 1972, Congress passed the Clean Water Act (CWA) (*33 USC 26 - Federal Water Pollution Control Act 1972*) to address water quality issues. In 1987, the CWA was revised with the Water Quality Act of 1987 and stormwater provisions for five stormwater discharge categories were added. Known as Phase I of the stormwater program, these provisions set restrictions on large and medium Municipal Separate Storm Sewer System (MS4) discharge quality through National Pollutant Discharge Elimination System (NPDES) permits (*40 CFR* § 122-124. *1990*). In 1990, final regulations were established for Phase I discharge categories and in 1999, final Phase II regulations were established for smaller MS4s, construction sites of 1 to 5 acres, and industries not included in Phase I. Phase II municipalities (small MS4s < 100,000 population) were required to obtain NPDES permits by 2003 (*40 CFR* § 122-124. *1995*). These provisions and regulations did not provide a steady, sufficient, nor dedicated source of funding for the required stormwater system improvements needed to maintain or obtain permitted status.

Efforts to maintain regulatory compliance, repair aging infrastructure, adapt to flood frequency and climate pattern changes (WEF 2013), and expand existing conveyance systems all contribute to increases in stormwater management program (SWMP) expenses. In order to maintain regulatory compliance with the CWA, local governments must adhere to new Total Maximum Daily Load (TMDL) requirements while managing increases in MS4 permit-associated costs and strained budgets (Busco and Lindsey 2001). Some permit holder's SWMPs call for retrofitting existing stormwater conveyance systems to prepare for TMDL implementation. A combination of aging infrastructure and a reactive maintenance approach has left municipalities with a long list of stormwater system repairs. Changes in rainfall intensity, flood frequency, and weather patterns have caused local governments to consider larger capacity stormwater system designs (WEF 2013). Due to the increase in expenses caused by these factors, many local governments face a pressing issue: How to find continuous, sufficient funding for the SWMPs needed to meet the requirements of the CWA, and control stormwater flow while improving stormwater quality. Stormwater user fees have become one prevalent option for developing revenues.

Stormwater user fee mechanisms take on many forms and variations but may be generalized into two major categories: utilities and fees. Stormwater utilities charge consumers for use of the municipal stormwater conveyance system and stormwater management services, including costs for system operation and maintenance, stormwater quality facilities, capital construction, and flood control facilities (NAFSMA 2006). "Usage" varies and is determined by the magnitude of stormwater runoff the consumer produces. Stormwater fees charge consumers a flat fee for the use of the municipal stormwater conveyance system and stormwater management services, regardless of consumer usage. The charges for usage and magnitude of fees vary between municipalities depending upon the magnitude of funds needed for the maintenance, quality control measures, and improvements required for the stormwater system and the willingness of consumers to pay (Debo and Reese 2002).

Several major methods of fee computation have become popular, including flat fees, Equivalent Residential Unit (ERU), Tier systems (TIER), and the Residential Equivalency Factor (REF) method. Flat fee methods charge categories of consumers a flat fee, ERU and select TIER methods are based upon impervious area (Campbell 2007-2013; Campbell et al. 2014), and the REF method is based on based upon the Natural Resource Conservation Service's (NRCS) runoff computation method (NRCS 1986) or the Rational Method (Kuichling 1889).

Among a sea of methods, local governments are searching for ideal SWMP funding mechanisms. In many cases, this means user fee funding tactics are being weighed against alternative mechanisms. An analysis of trends among user fee funding mechanisms will help identify important factors in the establishment, structuring, and magnitude of fees in user-fee funded stormwater programs across the U.S.

1.2 Problem Statement

Stormwater Management Programs (SWMPs) are seeking new funding methods to accommodate increases in expenses. However, local municipalities have a variety of stormwater funding approaches at their disposal. For the purpose of choosing a method best suited for their needs, knowledge of trends in establishment, implementation, and structure for a particular mechanism can prove helpful. The goal of this research is to identify potential influencing factors and trends in relation to fee magnitude, type, and establishment by analyzing a stormwater utility and fee database and thus provide guidance for municipalities in the choice of an appropriate funding mechanism.

1.3 Objectives

1. *Compile and validate stormwater utility/user fee database.*
   Dr. Warren G. Campbell, a professor at Western Kentucky University, has published the Western Kentucky University Stormwater Utility Survey annually since 2007, resulting in a national database of stormwater user fees. This research included collaboration with Dr. Campbell to verify and update the 2013WKU SWU survey database in order to create the 2014 database (Campbell 2007-2013; Campbell et al. 2014).

2. *Restructure database to allow for statistical analysis.*
   Upon complete review and updating of the 2014 database, the resulting database was restructured, existing variables redefined, and new variables added to allow for detailed statistical analysis.

3. *Determine factors to utilize in trend analysis.*
   New factors were incorporated from 2010 U.S. Census Bureau data, U.S. Geological Survey Geographic Names Information System data (USGS 2013), National Climatic Data Center data, and Tiger/Line shapefiles (U.S. Census Bureau 2014). These factors included the following:
   a) Population density as an indicator of intensity of development

b) Home value as an indicator of impervious area
c) Geographic characteristics such as area of municipalities, area of water (within municipalities), U.S. climate regions, and municipality latitude and longitude coordinates.

4. *Incorporate factors into the stormwater user fee database.*
The new factors were incorporated into the stormwater user fee database using ArcGIS functions (ESRI 2014).

5. *Determine appropriate analysis methods.*
Both statistical and non-statistical methods were employed over the course of this research. Statistical analysis utilized non-parametric techniques such as the Median Rank test, the Wilcoxon test, and Spearman's ρ. Non-statistical methods included a time-series analysis which observed stormwater user fee establishment near years of legislation enactment and regulation deadlines.

6. *Analyze the stormwater utility/user fee database using aforementioned methods for trends in establishment, fee type, and monthly rate.*
To determine trends in fee type, monthly rate, and ERU area, the impacts of 1) geographic location, 2) population density, and 3) home value were observed by applying the Median Rank test, Wilcoxon test, and Spearman's ρ. To determine trends in establishment, the percentage of user fees established in a given year was compared to legislative enactment and regulation deadlines.

7. *Compile trend observations for the consideration of municipalities and readers.*
At the conclusion of this research, a set of 5 tables was compiled for consideration. These tables contain general database observations and statistically significant observations obtained from this research. These tables, along with knowledge of local legal environments and stormwater management funding needs, may be used as guidance in stormwater user fee formation and research.

1.4 Stormwater User Fee Database Development

For the purpose of this research a stormwater user fee database was developed from the 2013 WKU SWU Survey database (Campbell 2007-2013). Initial phases of dataset development included a review of the existing database. After a full review, the database was published as the 2014 WKU SWU survey (Campbell et. al. 2014). The 2014 WKU SWU Survey database was then modified for statistical analysis before new information was added. It is this database, the stormwater user fee (SUF) database, which was used for analysis in this research.

1.4.1 2014 WKU SWU Survey Database Review and Compilation

Review of the 2013 WKU SWU database included an internet, phone, interview, and email correspondence based data collection process. All 1417 record sources (internet links) were reviewed for updates to user fees (including fee structure and magnitude alterations), changes in source or source location, and repeals. For select records, updates were obtained from interviews and email correspondence with municipal professionals. Approximately 85 of the records could not be located via the internet review. These municipalities were contacted via phone for further clarification. Throughout the review process, any newly located user fee programs were added to the database as well.

Upon completion of the 2013 WKU SWU survey database review the database was restructured and additional data was added. Additional fields were created to designate user fee structure variations (see Appendix A for database excerpt). The United States Board on Geographic Names' Geographic Names Information System (GNIS) database (USGS 2013) was used to determine latitude, longitude, and GNIS feature ID (a unique identifier) for each municipality. 2010 summary file census data was utilized to update population data, add median home value estimates, and add dwelling unit counts. The U.S. Census Bureau Topologically Integrated Geographic Encoding and Referencing, TIGER/line, products (U.S. Census Bureau 2014) were used to obtain area of land and area of water. Lastly, National Oceanic and Atmospheric Administration climate regions were associated with each municipality (NCDC 2015).

2 Literature Review

2.1 Contributors to funding needs of Stormwater Management Programs

Efforts to maintain regulatory compliance, repair aging infrastructure, adapt to flood frequency and climate pattern changes (WEF 2013), and expand existing conveyance systems all contribute to increases in stormwater management program (SWMP) expenses. In order to maintain regulatory compliance with the CWA, local governments must adhere to new Total Maximum Daily Load (TMDL) requirements while managing increases in MS4 permit-associated costs and strained budgets (Busco and Lindsey 2001). Some permit holder's SWMPs call for retrofitting existing stormwater conveyance systems to prepare for TMDL implementation. A combination of aging infrastructure and a reactive maintenance approach has left municipalities with a long list of stormwater system repairs. Changes in rainfall intensity, flood frequency, and weather patterns have caused local governments to consider larger capacity stormwater system designs (WEF 2013).

2.2 Stormwater Management Program funding mechanisms

Stormwater Management Programs may be funded using a variety of methods such as taxes, service charges, exactions, and assessments. Taxes are exacted to raise revenues. Service charges are created to fund regulatory activities for specific program and are related to the costs of providing services. Exactions are tied to extended privileges to use such as fees for right-of-way use, impact fees, and licenses. Assessments are fees charged to a limited group of individuals for improvements that will only benefit the group (Debo and Reese 2002). In particular, stormwater management programs have been funded by methods such as sales taxes, property taxes, "set asides" from general tax funds, impact fees, and user fees. The user fee method has emerged as a new, major method (Campbell 2007-2013, Campbell et. al 2014).

Stormwater user fee mechanisms take on many forms and variations but may be generalized into two major categories: utilities and fees. Stormwater utilities charge consumers for use of the municipal stormwater conveyance system and stormwater management services, including costs for system operation and maintenance, stormwater quality facilities, capital construction, and flood control facilities (NAFSMA 2006). "Usage" varies and is determined by the magnitude of stormwater runoff the consumer produces. Stormwater fees charge consumers a flat fee for the use of the municipal stormwater conveyance system and stormwater management services, regardless of consumer usage. The charges for usage and magnitude of fees vary between municipalities depending upon the magnitude of funds needed for the maintenance, quality control measures, and improvements required for the stormwater system and the willingness of consumers to pay (Debo and Reese 2002). The stormwater utility category can be further divided based upon methods employed for the determination of usage.

Usage is often dictated by impervious area or surfaces that do not allow water to infiltrate into the ground (e.g. rooftops, sidewalks, and driveways). Impervious area is considered the most influential factor in determining peak stormwater runoff rates, total discharge volume, and pollutant contributions (NAFSMA 2006). As impervious area increases, the volume of stormwater produced rises (Booth et al. 2002). The methods for measuring impervious area and establishing a service utility can vary widely, but the NAFSMA publication describes methods based on four major factors: 1) impervious area, 2) a combination of impervious area and gross area, 3) impervious area and the percentage of imperviousness, and 4) gross property area and the intensity of development. Impervious area methods account for the volume of stormwater produced only from impervious areas. These methods are easier to apply than others; however, they do not account for runoff infiltration from other land cover types.

Methods that use impervious and gross property area seek to determine the total volume of stormwater as opposed to simply the volume produced by impervious surfaces. Pervious and semi-pervious areas, such as lawns, allow some water to infiltrate the ground. Thus, the presence of either can impact the magnitude of stormwater runoff discharged to the stormwater conveyance system. Several methods exist that employ this same concept to determine volume but choose to charge fees based on the percentage of impervious area rather than actual impervious area. Other methods utilize gross area and intensity of development where intensity of development is gauged by assigning factors for different types of land-uses. Then, these factors are multiplied by the gross area of a parcel to determine the fee.

Several major methods of fee computation have become popular, including flat fees, Equivalent Residential Unit (ERU), Tier systems (TIER), and the Residential Equivalency Factor (REF) method. Flat fee methods charge categories of consumers a flat fee, ERU and select TIER methods are based upon impervious area (Campbell 2007-2013; Campbell et al. 2014), and the REF method is based on based upon the Natural Resource Conservation Service's (NRCS) runoff computation method (NRCS 1986) or the Rational Method (Kuichling 1889).

2.3 Legal Challenges

Successful stormwater user fees must often be able to withstand challenges in court. In approximately 17 states (Grigg 2012), user fees haven been litigated on issues of fee vs. tax classification, equitability, improper fee determination methods, and obligation to pay. The outcomes of these challenges depend on both state statutes and case facts.

The most common issue is the question of fee or tax classification. The factors considered in the determination of fee vs. tax status can vary but largely require that 1) the costs must be reasonably associated with the services provided, 2) the fee should be voluntary, 3) the fee should be considered equitable, and 4) the fee must be exacted for regulatory, not revenue raising, purposes. If fees are deemed to be taxes then tax-exempt organizations may debate the obligation to pay (NAFSMA 2006). If the fee was established by the passing of an ordinance, which is almost always the case, in a state where taxes must be voted on and it is deemed a tax then, the fee will be considered illegal (Bolt v. Lansing 1999) and repealed. In order to reduce the potential for repeal, decision makers must form fees that can withstand court challenges and be aware of the successful user fee methods employed by others.

2.4 Stormwater User Fee Trends

Recent attempts to explore trends in stormwater user fee computation methods, establishment, and magnitude have been made in regional and national studies. These studies include the Black and Veatch Stormwater Utility (SWU) Survey (Black & Veatch 2013), the Southeast Stormwater

Association SWU survey (SESWA 2011), and the Western Kentucky University Stormwater Utility (WKY SWU) Survey (Campbell 2007-2013; Campbell et al. 2014). The 2014 Black & Veatch SWU survey gathers stormwater utility fee program characteristics for a sample of the overall stormwater fee population (*n* <100) via an online questionnaire. The SESWA SWU survey provides information on user fee programs in Southeast EPA Region 4, excluding Florida. In contrast, the WKU SWU survey is a national data-gathering effort, rather than a classical survey.

The WKU SWU Survey was first published in 2007 and since then, the survey has been published annually and has sought to identify different trends for a growing number of stormwater user fee systems across the U.S. (currently *n*= 1490). The WKU survey has identified prevalent methods, observed spatial patterns, compared fee types (including REF and ERU systems), located political challenges, computed summary statistics, and explored the variable factors related to select fee methods (REF rainfall and ERU impervious area) (Campbell 2007-2013; Campbell et al. 2014). Each survey includes a detailed account of the following variables:

- Municipality name and state
- Fee type/ method
- ERU area (if applicable)
- Residential monthly fee
- Commercial monthly fee (if different)
- Date established
- Annual revenue
- Data sources (internet, interview, and survey based)
- Court challenges
- Repealed user fees

The WKU SWU has employed a series of techniques, including spatial analysis, the comparison of fee types and the observation of legal challenges, to discern trends and potential influential factors. For spatial analysis, the WKU SWU survey has observed the geographical distribution of monthly rates and ERUs. To analyze the implications of the REF fee type, the survey has created a set of hypothetical scenarios. In one instance the REF system was compared to the ERU system by applying both techniques to Medina, Minnesota (Campbell 2011). Here, it was found that both systems were comparable. However, the REF method provided a better gauge of the runoff produced by undeveloped properties. In another scenario, the survey studies the impact of the utilized precipitation frequency estimate on REF fee computation. It was determined that rainfall magnitudes can greatly impact the REF method and are prone to manipulation.

2.5 Summary

Stormwater user fees are a popular stormwater funding mechanism that can enable municipalities to fund the growing expenses associated with SWMPs. Currently a large number of methods for determining user fees exist and municipalities considering them must choose fee types and computation methods that work best for them. What works best for one does not work best for another and in the face of legal challenges decision makers require knowledge of successful user fees. Previous studies have attempted to discern trends. However, little research has been performed using statistical trend analysis techniques such as hypothesis testing or correlation tests. This research analyzes a stormwater user fee database for spatial, structural, rate based, and administrative trends nationally using the aforementioned techniques. Then, it provides a list of observations to aid decision makers in the process of establishing a stormwater user fee.

3 An Analysis of Trends in U.S. Stormwater Utility & Fee Systems

3.1 Introduction

Urban development has been linked to changes in municipal stormwater runoff quality and quantity (NRC 2009). Developed areas produce larger magnitudes of runoff from increases in impervious surfaces, runoff with higher concentrations of pollutants such as total suspended solids, nutrients, organic chemicals, and trace metals from human activities (Schueler 2003), and changes in runoff temperatures (Sabouri et al. 2013). These increased magnitudes of polluted runoff are routed to streams and rivers, which then experience increases in peak discharge, volume, bankfull flow and pollutant loads (Leopold 1968; McCuen and Moglen 1988; Schueler 2003; Schoonover et al. 2006). Therefore, urban stormwater runoff, now identified as a point source discharge, is considered a major source of water pollution (Shaver et al. 2007) and detrimental to local waterways (Paul and Meyer 2001).

In response to the urban stormwater problem (NRC 2009), legislation was passed to require control of stormwater quantity and quality from developed areas across the U.S. In 1972, Congress passed the Clean Water Act (CWA) (33 USC 26 - Federal Water Pollution Control Act 1972) to address water quality issues. In 1987, the CWA was revised with the Water Quality Act of 1987 and stormwater provisions for five stormwater discharge categories were added. Known as Phase I of the stormwater program, these provisions set restrictions on large and medium Municipal Separate Storm Sewer System (MS4) discharge and quality through National Pollutant Discharge Elimination System (NPDES) permits (40 CFR § 122-124. 1990). In 1990, final regulations were established for Phase I discharge categories and in 1999, final Phase II regulations were established for smaller MS4s, construction sites of 1 to 5 acres, and industries not included in Phase I. Phase II municipalities (small MS4s < 100,000 population) were required to obtain NPDES permits by 2003 (40 CFR § 122-124. 1995). These provisions and regulations did not provide a steady, sufficient, nor dedicated source of funding for the required stormwater system improvements needed to maintain or obtain permitted status.

Efforts to maintain regulatory compliance, repair aging infrastructure, adapt to flood frequency climate pattern changes, and expand existing conveyance systems all contribute to increases in stormwater management program (SWMP) expenses (WEF 2013). In order to maintain regulatory compliance with the CWA, local governments must adhere to new Total Maximum Daily Load (TMDL) requirements while managing increases in MS4 permit-associated costs and strained budgets (Busco and Lindsey 2001). Some permit holder's SWMPs call for retrofitting existing stormwater conveyance systems to prepare for TMDL implementation. A combination of aging infrastructure and a reactive maintenance approach has left municipalities with a long list of stormwater system repairs. Changes in rainfall intensity, flood frequency, and weather patterns have caused local governments to consider larger capacity stormwater system designs (WEF 2013). Due to the increase in expenses caused by these factors, many local governments face a pressing issue: How to find continuous, sufficient funding for the SWMPs needed to meet the requirements of the CWA, and control stormwater flow while improving stormwater quality.

Stormwater user fees have become one prevalent option for developing revenue. Stormwater user fee mechanisms take on many forms and variations but may be generalized into two major categories: utilities and fees. Stormwater utilities charge consumers for use of the municipal stormwater conveyance system and stormwater management services, including costs for system operation and maintenance, stormwater quality facilities, capital construction, and flood control facilities (NAFSMA 2006). “Usage” varies and is determined by the magnitude of stormwater runoff the consumer produces. Stormwater fees charge consumers a flat fee for the use of the municipal stormwater conveyance system and stormwater management services, regardless of consumer usage. The charges for usage and magnitude of fees vary between municipalities depending upon the magnitude of funds needed for the maintenance, quality control measures, and improvements required for the stormwater system and the willingness of consumers to pay (Debo and Reese 2002). The stormwater utility category can be further divided based upon methods employed for the determination of usage.

Usage is often defined by the impervious area or surfaces that do not allow water to infiltrate into the ground (e.g. rooftops, sidewalks, and driveways). This is because impervious area is considered the most influential factor in determining peak stormwater runoff rates, total discharge volume, and pollutant contributions (NAFSMA 2006). As impervious area increases, the volume of stormwater produced rises (Booth et al. 2002). The methods for measuring impervious area and establishing a service utility can vary widely, but the NAFSMA publication describes methods based on four major factors: 1) impervious area, 2) a combination of impervious area and gross area, 3) impervious area and the percentage of imperviousness, and 4) gross property area and the intensity of development. Impervious area methods account for the volume of stormwater produced only from impervious areas. These methods are easier to apply than others; however, they do not account for runoff infiltration from other land cover types.

Methods that utilize impervious and gross property area seek to determine the total volume of stormwater as opposed to simply the volume produced by impervious surfaces. Pervious and semi-pervious areas, such as lawns, allow some water to infiltrate the ground. Thus, the presence of either can impact the magnitude of stormwater runoff discharged to the stormwater conveyance system. Several methods exist that employ this same concept to determine volume but choose to charge fees based on the percentage of impervious area rather than actual impervious area. Other methods utilize gross area and intensity of development where intensity of development is gauged by assigning factors for different types of land-uses. These factors are then multiplied by the gross area of a parcel to determine the fee.

Several major methods of fee computation have become popular, including flat fees, Equivalent Residential Unit (ERU) or Equivalent Service Unit (ESU), Tier systems (TIER), and the Residential Equivalency Factor (REF) method. Flat fee methods charge categories of consumers a flat fee, ERU and select TIER methods are based upon impervious area (Campbell 2007-2013; Campbell et al. 2014), and the REF method is based on runoff and utilizes techniques such as the Natural Resource Conservation Service’s (NRCS) runoff computation method (NRCS 1986) or the Rational Method (Kuichling 1889). .

The ERU method is based upon the average amount of impervious surface area on a residential parcel, or the ERU Area Unit (Equation 3.1), typically given in square feet (sqft.). Each property is assessed to determine how many ERUs it possesses by dividing the property’s amount of impervious area by the ERU area (Equation 3.2). A fee assessment rate per ERU is established and all properties are assessed accordingly (Equation 3.3).

$$\text{ERU Area} = \frac{\text{total residential impervious area (sqft.)}}{\text{total number of residential parcels}} \qquad \text{(Equation 3.1)}$$

$$\text{Number of ERUs per parcel} = \frac{\text{total parcel impervious area}}{\text{ERU Area}} \qquad \text{(Equation 3.2)}$$

$$\text{Total fee} = \#\text{ of ERUs} \times \text{ERU rate} \qquad \text{(Equation 3.3)}$$

A municipality may choose to charge all properties a rate per ERU or modify the procedure using one of many approaches. In some cases, single-family parcels are assessed the fee for one ERU, regardless of the number of ERUs they may have. Meanwhile, all other properties are charged for the total number of ERUs associated with their parcel. In other cases, single-family parcels up to a maximum size are assessed for one ERU; the remaining properties are charged for all ERUs.

Properties can also be assessed for a number of ERUs based upon a tier system. Tier systems assign fees or factors, such as number of ERUs, based upon categories. These tiers can be based upon numerical factors, such as the magnitude of impervious area or water use, or categorical factors, such as land-use type or water meter size. Tier systems can be applied to all properties or only to select property types such as commercial properties. In many cases, tier systems charge a flat fee for various ranges of impervious area. The following two tables show examples of tier systems.

Table 3.1 : Residential Tier System for Flagstaff, AZ

Tier	Impervious Area (sqft)	Monthly Fee
Residential 1	200 - 1500	$1.30
Residential 2	1501 - 3000	$2.60
Residential 3	3001 - 4500	$3.90
Residential 4	4501 - 6000	$5.20
Residential 5	> 6000	$6.50
Other	1 ERU = 1500 SF IA	$1.30/ERU

Flagstaff, Arizona, Municipal Code §12.02.002.0003

Table 3.2 : Parcel Type Tier System for Niceville, FL

Parcel Description	Monthly Fee
Single Family Residential	$4.51
Other Residential	$4.51/unit
Institutional	$4.51/structure + $4.51/7500 sqft. of impervious area
Commercial	$9.03 + $4.51/7500 sqft. of impervious area
Vacant - Cleared Lots	$1.73/acre
Vacant - Non-Cleared Lots	$0.00

Niceville, Florida, Municipal Code §20.217

Previous national, regional, and statewide surveys have attempted to identify trends in user fee structure and establishment. These include the Black and Veatch Stormwater Utility (SWU) Survey (Black and Veatch 2013), the Southeast Stormwater Association SWU survey (SESWA 2011), and the Western Kentucky University Stormwater Utility (WKY SWU) Survey (Campbell 2007-2013; Campbell et al. 2014). The 2014 Black and Veatch SWU survey gathers stormwater utility fee program characteristics for a sample of the overall stormwater fee population (*n* <100) via an online questionnaire. The SESWA SWU survey provides information on user fee programs in Southeast EPA Region 4, excluding Florida. In contrast, the WKU SWU survey is a national data-gathering effort, rather than a classical survey.

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Previous studies have not utilized statistical methods such as hypothesis testing to analyze stormwater user fee data on a national scale. Furthermore, stormwater user fee data has not been correlated with municipality characteristics to discern trends and influencing factors. Previous studies have also lacked recommendations for stormwater user fee program characteristics based upon factors such as population or geographic location. The first goal of this research is to analyze a national stormwater user fee database for spatial, fee type, monthly rate, and date of establishment trends, thus providing a means of identifying recommended fee type and characteristics based upon local, regional, and national observations. The second goal is to compile a set of recommendations to provide guidance for municipalities in the choice of an appropriate stormwater user fee type and rate.

3.2 Database Summary

The stormwater user fee (SUF) database used for analysis was developed through a collaborative effort with the Western Kentucky University Stormwater Utility Survey (WKU SWU Survey). The 2013 version of the survey was reviewed and updated, and additional indicators of fee structure were added along with newly located user-fee systems. The verification process included a review of the aforementioned factors for every existing 2013 record through municipal websites, regional surveys, phone calls to municipalities, interviews, and email correspondence. Upon completion, the revised database was published as the 2014 WKU SWU survey. Then, the SUF database was formed from the 2014 survey database. The full SUF database contains relevant information and characteristics for 1490 municipalities with stormwater user fees. Table 3.3 provides a listing of each of the fields within SUF database, which include fee type, ERU area, and monthly fee, along with a brief description.

Table 3.3: Database Variable Summary

Database Field Name	Description
Municipality	Field contains the name of the city, county, town, or district in which the stormwater user fee exists.
State	Field contains the name of the state in which the stormwater user fee exists.
Fee Type	Field describes the type of computation method used for utilities and denotes fees.
ERU Area	If the fee type is an ERU, field gives the ERU area in sqft.
Monthly Rate	Field contains the monthly charge to residential consumers. In cases where the fee type is an ERU, field displays the monthly charge per ERU.
Source	Field contains source(s) utilized for obtaining the denoted data.
Population	Field contains 2010 Census population counts from 2010 census summary tables (U.S. Census Bureau 2010).
Annual Revenue	Field contains the total revenue received from the charging of a utility or fee.
Challenge	Field indicates the occurrence of a legal challenge against the fee described.
Challenge Result	Field describes the result of the legal challenge against the user fee described. Some challenges resulted in repeals.
Area of Land	Field lists the total area of land in the municipality, excluding water bodies.
Median Home Value	Field gives the municipality 2010 Census estimated median home value in dollars (U.S. Census Bureau 2010).
NOAA Climate Region	Field indicates the NOAA Climate Region in which the given municipality is located.
Population Density	Field contains a value for population density computed from population and area of land.
Home Value Factor	Field contains a unit-less factor for home value computed from the median home value.

Tables 3.4 and 3.5 provide further describe the fee type field and characteristics of the SUF database. Table 3.4 gives the name and a brief description for each of the 10 fee types utilized in the SUF database. These fee types include the ERU, REF, Tier, Flat Fee, and per squarefoot methods in addition to charges determined by water usage and water meter size. Table 3.5

provides summary statistics for each fee type including the median, maximum, and minimum monthly fee, number of court challenges, and total number of user fees repealed.

Table 3.4: Fee Type Descriptions

Method	Description
ERU	User fees that determine usage based upon impervious area. One ERU is equivalent to the average amount of impervious area on residential properties. Typically, a charge is assessed per ERU utilized.
Flat Fee	User fees that charge a flat rate to users of a stormwater conveyance system.
Tier	A system where consumers are categorized based upon a select variable and charged accordingly.
Residential Equivalence Factor (REF) (or similar)	User fees that determine usage using the NRCS runoff or Rational method.
Dual (Residential/Commercial)	User fees that assess different rates or use different methods (often Fixed Rate and ERU) for commercial and residential properties.
Per Parcel Square Foot (Sqft.)	User fees that charge a rate per parcel sqft. of imperviousness.
Per Parcel Acre	User fees that charge a rate per parcel acre of imperviousness.
Water Meter	User fees that charge based upon the size of a parcel's water meter. (Often exhibited in tier systems)
By Water Usage	User fees that charge according to parcel water usage.

Table 3.5: 2014 Database Summary Statistics

	ERU	Tier	Flat Fee	REF	Two Level	Per Acre	Per Sqft.	Water Meter	Water Use	Total
n	709	228	221	126	89	9	23	4	4	1413*
Median Monthly Fee	$4.02	$4.00	$3.17	$3.90	$3.30	$5.00	$3.76	$1.88	$1.50	$4.00
Max Monthly Fee	$35.00	$30.00	$18.18	$19.43	$14	$34.39	$13.05	$5.53	$2.50	$35
Min. Monthly Fee	$0.90	$0.31	$0.01	$0.67	$0.25	$2.00	$0.04	$1.75	$0.95	$0.01
Court Challenge	41	14	3	1	8	2	2	0	0	84**
Total Repealed										13

*For the remaining records (*n*=77) either only the existence of the fee was verified or the fee program was repealed.
**Total includes court challenges that resulted in the repeal of a stormwater user fee.

Figure 3.1 displays the location of all the stormwater user fees in the SUF database excluding water meter (*n*=4) and water usage based systems (*n*=4). Each symbol on the map represents a stormwater user fee locality. The symbol shapes represent various fee types (10) in the SUF database. Figure 3.1 illustrates that stormwater user fees are common in some states and virtually non-existent in others. It is also clear that fee types may be linked to geographical location as demonstrated in the enlargement of Minnesota. Here the REF type user fees, denoted by diamonds, exist in large numbers.

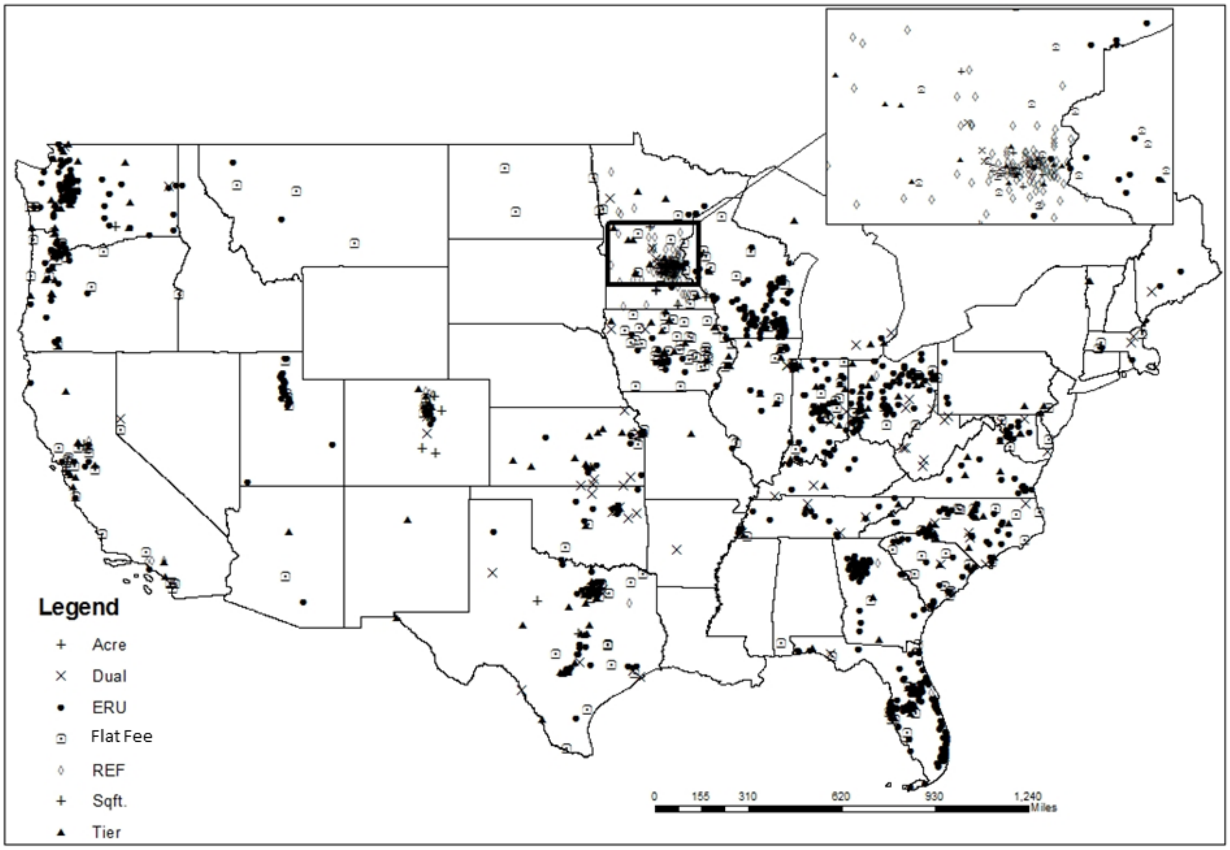

Figure 3.1: National Stormwater Utility Map (excluding Alaska and Hawaii)

As denoted in Table 3.3, information on municipality population density, relative median home value, National Oceanic and Atmospheric Administration (NOAA) Climate Regions, and NPDES MS4 permit type is included in the SUF database. Population density has been linked to impervious area (Stankowski 1972). Municipalities with high values of population density (cities) often experience higher levels of intensity of development and incur a higher set stormwater management costs than municipalities with low values of population density. Densely populated municipalities may also utilize different fee computation methods due to the availability of resources and personnel. Therefore, population density was determined for each municipality in the SUF database by dividing the population by the municipal area. Computed population density values ranged from 0.02 to 3.4 people per 1000 square feet across the U.S.

Home value, like population density, can indicate a number of scenarios in a municipality. If parcel sizes are taken to be similar, high value homes are also more likely to have relatively less green space than low value homes depending upon location (Nasar et al. 2007). For the purpose of stormwater management, this can mean higher volumes of stormwater (Schoonover 2006; Schueler 2003) and thus potentially higher stormwater management costs. A home value factor was utilized in this analysis to examine this relationship.

The home value factor was computed for each municipality from 2010 census data median home value estimates. Median home values were normalized nationally to allow for fluctuations in property value for different locations in the U.S. (Equation 3.4).

$$\text{H.V. Factor}=\frac{\text{Home Value (dollars)}}{\text{National H.V. Median}} \qquad \text{(Equation 3.4)}$$

Figure 3.1 shows that geographic location may impact stormwater user fee establishment and fee type. User fees appear to be prevalent in some areas, such as Washington and Oregon, and not in others, such as North Dakota and South Dakota. Fee types such as the REF and ERU appear to be prevalent in Minnesota. The ERU appears to prevalent in Ohio and Indiana. Therefore, NOAA Climate Regions were determined for each municipality to aid in identifying regional trends.

NOAA climate regions, identified by the National Climatic Data Center (NCDC) scientists, assign U.S. states to regions according to climate similarities (NCDC 2015). Figure 3.2 shows user fees and the nine NOAA Climate Regions in the U.S., excluding Alaska and Hawaii. Below each climate region name is the number of user fees located within the region. Here, it can be seen that some regions, such as the East North Central, have many SUFs and others, such as the West North Central, do not. Table 3.6 provides a summary of the number of user fees identified within each NOAA Climate Region according to fee type. The *n* values given for each region contain repealed user fees and fees whose existence was verified but fee type was not (*n*= 77).

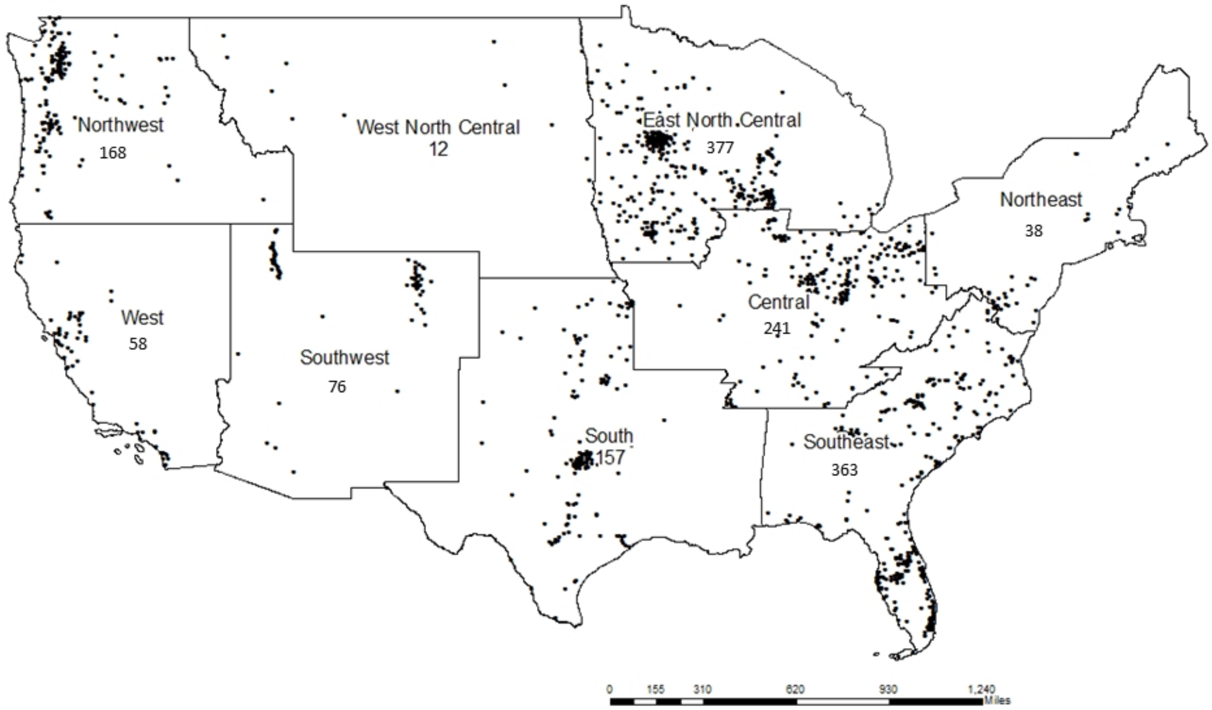

Figure 3.2: NOAA Climate Regions and Stormwater User Fees

Table 3.6: NOAA Climate Region SWU Summary

Climate Region	Central	East North Central	Northeast	Northwest	South	Southeast	Southwest	West	West North Central	Total *
ERU	132	127	15	94	54	242	35	8	2	709
Tier	35	34	8	42	41	48	10	9	0	228
Flat Fee	30	69	7	17	30	36	8	18	6	221
REF	4	105	0	2	1	5	4	5	0	126
Dual	25	15	6	3	22	13	3	2		89
Per Sqft.	0	3	0	0	5	0	11	4	0	23
Per Acre	1	6	0	1	0	1	0	0	0	9
Water Usage	3	0	0	0	0	0	0	1	0	4
Water Meter	0	0	0	1	1	1	0	0	1	4
n **	241	377	38	168	157	363	76	58	12	1490

* Table excludes repealed user fee type and verified user fee type (user fees whose existence was verified but the fee type was not) (*n*=77).
** The *n* values given for each region contains repealed user fees and fees whose existence was verified but fee type was not (*n*= 77).

MS4 Permit type (Phase I or Phase II) was determined using the MS4 Permit population requirements. Municipalities with populations greater than 100,000 were placed into the Phase I category and any entity operating a MS4 in an "Urbanized Area" were placed into the Phase II category (40 CFR § 122-124. 1995). Urbanized areas consist of populations less than 100,000 and greater than 2,500 and can consist of city, county, and unincorporated properties. For the purpose of this research, all municipalities with populations over 100,000 were taken to have a MS4 Phase I permit and all those with populations below 100,000 and above 2,500 were taken to have a MS4 Phase II permit, even though there are exceptions. Those with populations below 2,500 were not utilized in analysis involving the MS4 Permit Type variable. Of the 1490 municipalities in the database, 212 were assigned MS4 Phase I permits and 1139 were assigned MS4 Phase II permits.

3.3 Methods

The first major goal of this research is to discern trends in stormwater user fee type, magnitude, and establishment. To accomplish this goal, the relationships between 1) geographic location, 2) population density, and 3) home value and SUF characteristics in addition to 4) legislation and establishment were observed using statistical and time series based analysis techniques. Statistical analysis included techniques suited for the observation of relationships between two categorical variables, categorical and continuous variables, and two continuous variables. Times series analysis included derived techniques for the observation of the impact of major legislation and regulatory deadline upon the establishment of stormwater utilities and fees.

An initial analysis of frequency distribution was performed on all tested variables to determine the distribution type. Distribution type, normal or non-normal, impacted the selection of statistical tests utilized throughout the study. Figure 3.3 depicts distribution analysis of monthly rate according to fee type. Each histogram depicts the frequency of occurrence of the given fee type at a particular range of monthly rates. In this case, monthly rate was found to exhibit non-normal distribution when categorized by fee type. In most cases, variables were found to have a non-normal distribution and thus non-parametric statistical methods were utilized to analyze the SUF database. The following sections summarize the methods used to analyze categorical vs. categorical variables, categorical vs. continuous variables, and continuous vs. continuous variables and to perform the time series analysis.

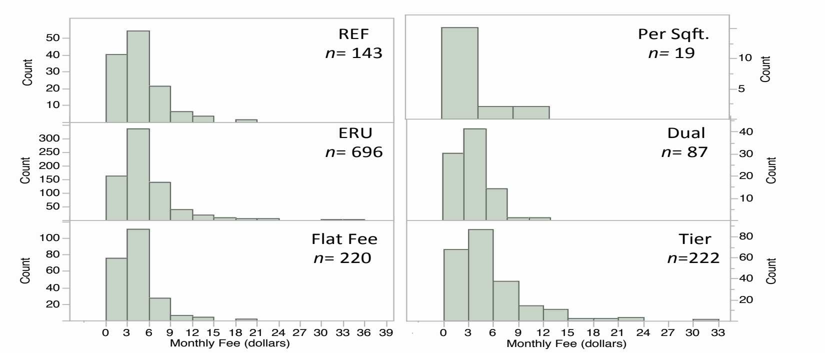

Figure 3.3 Frequency Distribution Analysis Sample

3.3.1 Categorical vs. Categorical Variable Analysis

The establishment of a stormwater user fee (SUF) and its fee type appear to correlate with its geographical location. Figure 3.1 indicates that the REF method is prevalent in Minnesota and methods such as ERUs and Flat Fees dominate the user fee sector in the areas surrounding Florida, Iowa, Washington, and Ohio. In order to observe spatial relationships among SUFs, categorical spatial variables such as the state and NOAA Climate Region were analyzed against fee type.

Contingency table analysis and Pearson's Chi Squared test for association were used to analyze the aforementioned categorical variables. Contingency table analysis allowed for the observation of trends in frequency distribution by yielding proportional values for sub-pairings such as number of ERU SUFs in the Southeast NOAA Climate Region. Upon completion of the contingency table analysis, a test for association between row and column categories was performed using Pearson's Chi Squared test.

The Pearson's Chi Squared test is a hypothesis-based test that allows for the observation of association among categorical variables (Gibbons and Chakraborti 2011). To perform the test, the chi squared test statistic is computed using proportions from the contingency table. Then, a null hypothesis, H_o, of no association is either accepted or rejected based upon the test statistic and/or p value of that test statistic. If H_o is rejected then the alternative hypothesis, H_a, of association is assumed to be true. For the purpose of this research, the p value was utilized to determine rejection or acceptance of H_o at $p = 0.05$.

3.3.2 Categorical vs. Continuous Variable Analysis

Categorical variables such as fee type were compared to continuous variables such as population density, home value, and monthly rate to isolate trends in the selection of fee type. Fee type was compared to population density to identify fee types that may be more common in densely or less densely populated municipalities. Densely populated municipalities, such as cities, often have more resources available (i.e. personnel, finances, and technology) than less populated municipalities, such as small towns. Some SUF methods are more labor intensive for municipalities to utilize than others. The ERU method requires a detailed account of impervious area on all parcels. To obtain detailed records, municipalities need personnel to either determine impervious areas physically or through software such as ArcGIS. Both of these options require personnel that have the skillset needed to carry out these tasks. However, a Flat Fee system does not require the cataloging of impervious area. A municipality with limited resources may elect to use a Fixed Rate SUF instead of an ERU. Therefore, a municipality may employ various SUF methods depending on the resources the municipality has available

Home value was compared to fee type to observe the impact of residential impervious area magnitudes on fee type selection. Higher magnitudes of runoff equate to varying degrees of stormwater management costs. Therefore, a relationship could exist between relative median home value and fee type selection. Municipalities with a relatively low median home value may choose to utilize a flat fee system. Conversely, municipalities with a relatively high median home value may choose to utilize a tier system for the sake of equitability.

Various SUF methods can yield different amounts of revenue for municipalities depending upon the number of consumers that utilize the stormwater management system. Flat Fee systems may appear to charge higher rates than ERU systems because ERU systems give monthly rates per ERU. Average monthly rates for charges exacted per square foot may differ from comparable tier systems that exact fees for a range of parcels. Fee type was compared against monthly rate to discern any of these types of trends.

All categorical vs. continuous variable trend analyses were performed using the median rank test and Wilcoxon test.

The median rank test, also known as Mood's median test (Brown and Mood 1951), utilizes hypothesis testing to identify the existence of a difference in median value among groups. The test compares the median of each group against the overall median using the Chi squared test statistic. Then, the H_o of no difference among medians for the groups is either rejected or accepted based upon the test statistic or p value. The median rank test is preferred for the purpose of this research due to its assumption of non-equal variance among groups. However, the median test does not provide an indication of which group medians differ from one another; the Wilcoxon test can (Wilcoxon 1945).

The Wilcoxon test was performed on each pair of groups after the median rank test to identify significant differences between groups when H_o was rejected. The Wilcoxon pairwise comparison test analyzes the difference between rank totals. The test performs a separate analysis for each possible combination of groups available using the W test statistic and associated critical values (Wilcoxon et al. 1970). For larger samples, W is then converted to the Z test statistic (Bagdonavicius et al. 2011). Based upon the test statistic or subsequent p value, the H_0 of no difference is either accepted or rejected. Since the statistic is computed for each group, an escalation in type I error, or the chance of rejecting H_o when H_o is true, occurs. The goals of this research place more value on the detection of differences than the accuracy of those difference detections; therefore the escalation in type I error was deemed acceptable and the Wilcoxon test was employed throughout the analyses.

3.3.3 Continuous vs. Continuous Variable Analysis

Tests for correlation were performed on continuous vs. continuous variable pairings, such as population density and monthly fee, using visual analysis via scatterplots and Spearman's ρ. High values of population density are linked to high values of impervious area which lead to higher stormwater management costs as larger capacity systems are maintained. Many SUF monthly rates are set to support these costs. Therefore, correlation between population density and monthly rate is expected.

Spearman's ρ correlation coefficient, a modification of Pearson's r, is formulated for use specifically for non-parametric data where a test for monotonicity occurs. According to Gibbons and Chakraborti, "[i]t measures the degree of correspondence between rankings instead of between actual variate values…" The interpretation of *ρ* (Equation 8, Gibbons and Chakraborti 2011) is comparable to the interpretation of Pearson's r; a value of zero indicates no correlation and a value of 1 indicates complete correlation. Throughout this study Spearman's ρ values ranged from 0 to 0.4. Spearman's ρ is often computed along with a p value for hypothesis testing. The H_o of mutual independence and the H_a of no mutual independence are utilized to determine the validity of *ρ*.

3.3.4 Time Series Analysis

Requirement deadlines imposed by major legislation, such as the NPDES Phase I and Phase II deadlines, or major legislation itself, such as the Water Quality Act of 1987 (WQA), are suspected to impact SUF establishment. As major deadlines approach and municipalities determine the total budget needed, a SUF may be deemed necessary in order to meet new regulations or receive and/or maintain permit status. A time series analysis was performed to determine if major legislative actions impacted the establishment of SUFs.

Time series analysis was performed using user fee establishment dates, the enactment date of the WQA, NPDES MS4 Phase I and II deadlines, and MS4 permit status. Counts of SUFs established were taken for each establishment year in record. From these values, proportions were calculated to determine the magnitude of user fee systems established in a given year relative to the dataset. The proportions were computed separately for MS4 Phase I and Phase II statuses.

For all tests, outliers were removed and categories with low n values were eliminated to provide more reliable analytical results. For Hypothesis testing procedures, the level of significance, α, was set to 0.05.

3.4 Results and Discussion

3.4.1 The Impact of Location

Spatial trend analysis was performed by analyzing three sets of variables: fee type (categorical) by NOAA Climate Region (categorical), fee type by State (categorical), and monthly fee (continuous) by NOAA Climate Region. Overall, spatial analysis showed that geographic location does have a significant impact on the fee type and magnitude. Table 3.7 provides an overview of the contingency analysis for fee type by climate region where water meter based and water usage based user fees were excluded as well as user fees that were repealed or whose characteristics could not be verified (n= 85). The NOAA Climate Region is shown in the first column and the various fee types are listed in the top row. Counts and percentages of the total dataset and region populate the table and the dark to light shade coloring scheme represents the degree of prevalence from most to least prevalent. For all climate regions except the West, the ERU is the most common fee type. The Tier system is the second most prevalent in all regions but the East North Central where the REF method follows close behind the ERU in terms of usage. In the West, the Flat Fee type is most common.

Table 3.7: Contingency Analysis of Fee Type vs. Climate Region

Climate Region (*n*)	Table $X^2 = 622.6$ $p < 0.001$	**Fee Type (*n*)**						
		ERU (709)	Tier (228)	Flat Fee (221)	Dual (89)	REF (126)	Sqft. (23)	Acre (9)
Central (241)	Count	132	35	30	25	4	0	1
	Percentage of Total	8.86	2.35	2.01	1.68	0.27	0.00	0.07
	Percentage of Fee Type	18.62	15.35	13.57	28.09	3.17	0.00	3.13
	Percentage of Region	54.77	14.52	12.45	10.37	1.66	0.00	0.41
East North Central (377)	Count	127	35	69	15	105	3	6
	Percentage of Total	8.52	2.35	4.63	1.01	7.047	0.20	0.60
	Percentage of Fee Type	17.91	15.35	31.22	16.85	83.33	13.04	66.67
	Percentage of Region	33.69	9.28	18.30	3.98	27.85	0.79	1.59
North-east (38)	Count	15	8	7	6	0	0	0
	Percentage of Total	1.01	0.48	0.47	0.40	0.00	0.00	0.00
	Percentage of Fee Type	2.12	3.47	3.17	6.74	0.00	0.00	0.00
	Percentage of Region	40.54	18.92	18.92	16.22	0.00	0.00	0.00
North-west (168)	Count	94	42	17	3	2	0	1
	Percentage of Total	6.31	2.82	1.14	0.20	0.14	0.00	0.07
	Percentage of Fee Type	13.26	18.42	7.69	3.37	1.58	0.00	3.13
	Percentage of Region	55.95	25	10.12	1.79	1.19	0.00	0.59
South (157)	Count	54	41	30	22	1	5	0
	Percentage of Total	3.62	2.75	2.01	1.48	0.07	0.34	0
	Percentage of Fee Type	7.62	17.98	13.57	24.72	0.79	15.63	0
	Percentage of Region	34.39	26.11	19.11	14.01	0.64	3.184	0
South-east (363)	Count	242	48	36	13	5	0	1
	Percentage of Total	16.24	3.22	2.42	0.87	0.34	0.00	0.07
	Percentage of Fee Type	34.13	21.05	16.29	14.61	3.97	0.00	3.125
	Percentage of Region	66.67	13.22	9.92	3.581	1.38	0.00	0.28
South-west (76)	Count	35	10	8	3	4	11	0
	Percentage of Total	2.35	0.67	0.54	0.20	0.27	0.74	0
	Percentage of Fee Type	4.94	4.39	3.62	3.37	3.17	34.38	0
	Percentage of Region	46.05	13.16	10.53	3.95	5.26	14.47	0
West (58)	Count	8	9	18	2	5	4	0
	Percentage of Total	0.54	0.60	1.21	0.13	0.34	0.27	0
	Percentage of Fee Type	1.13	3.95	8.14	2.25	3.97	12.5	0
	Percentage of Region	13.79	15.52	31.03	3.45	8.62	6.89	0
West North Central (12)	Count	2	0	6	0	0	0	0
	Percentage of Total	0.13	0.00	0.40	0.00	0.00	0.00	0.00
	Percentage of Fee Type	0.28	0.00	2.71	0.00	0.00	0.00	0.00
	Percentage of Region	16.67	0	50	0	0	0	0

Most Prevalent				Least Prevalent

Fee type was analyzed by state using the same technique and yielded similar results. The ERU method remained one of the most prevalent types. However, the REF method is most popular in Minnesota, which is included in the East North Central region. Tier methods follow in popularity; REF and Dual systems appear to be the least common.

Analysis of monthly fee by NOAA Climate Regions compared the median monthly rates associated with each region. Testing showed significant differences between the median monthly rates for the Northwest and East North Central Regions and for the Northwest and Central Regions ($p < 0.0001$). Five other significant differences between regions with p-values less than 0.001 and eight significant differences with p-values between 0.05 and 0.002 were identified. Figure 3.4 depicts a boxplot of the monthly fee categorized by NOAA Climate Region. The figure illustrates that the median monthly fee in the Northwest region is much larger than the East North Central and Central regions, leading to the conclusion that regional location can impact monthly fee magnitudes.

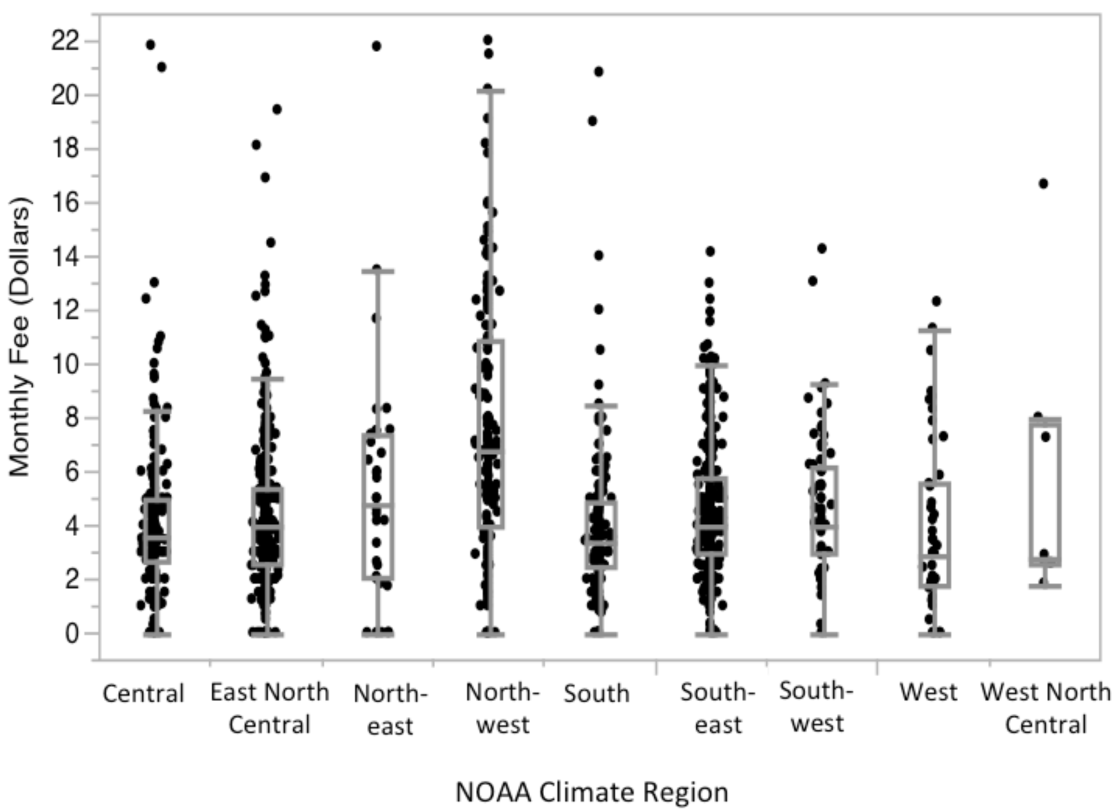

Figure 3.4: Boxplot of Monthly Fee Categorized by NOAA Climate Region

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3.4.2 The Impact of Population Density

The impact of population density was observed by analyzing by fee type, monthly rate, and ERU area. Analysis by fee type detected differences between the median population density values associated with each fee type. Further analysis revealed that significant differences, with p-values less than 0.05 and greater than 0.001, exist between Sqft. and Flat Fee, Tier and Flat Fee, REF and Flat Fee, Sqft. and Dual, and Flat Fee and ERU systems. The most significant difference, with a p-value less than 0.0001, was detected between Flat Fee and ERU systems.

Figure 3.5 depicts a boxplot of population density categorized by fee type. The figure illustrates a visible difference between the median population density of ERUs and Flat Fees where Flat Fees exhibit a lower median population density. Both visual and statistical analysis suggest that ERU systems appear to be present in municipalities with high and low population densities whereas flat fee systems appear to be prevalent in municipalities with lower population densities.

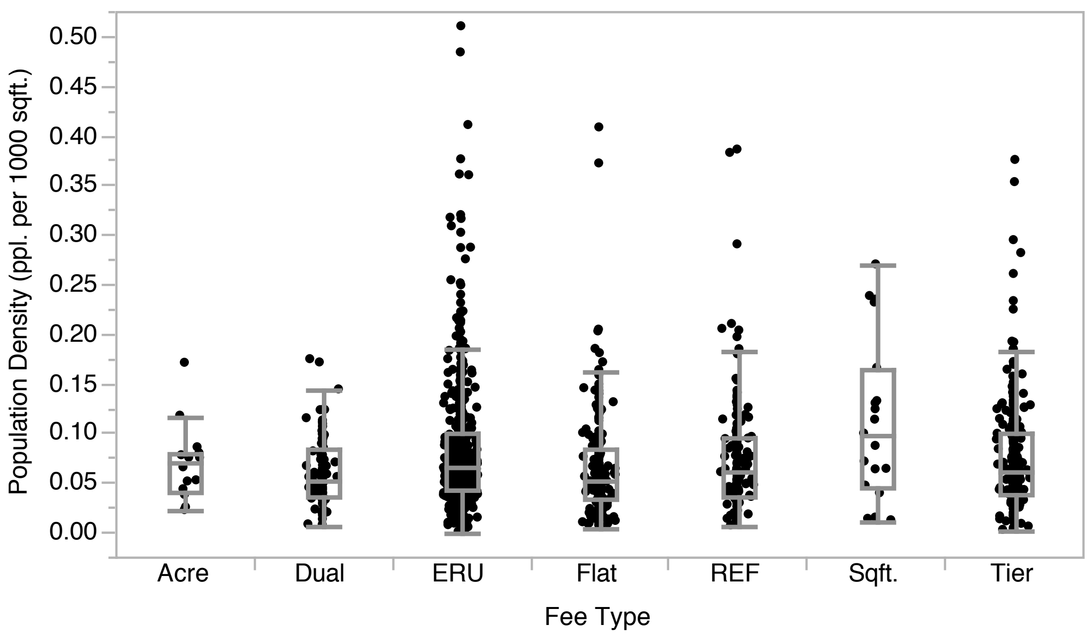

Figure 3.5: Boxplot of Population Density Categorized by Fee Type

Spearman's ρ was used to observe the relationship between population density and monthly fee. The test for correlation yielded a Spearman's ρ of 0.21. Therefore for 21% of the municipalities, as population density increases monthly fee increases. This indicates that for 21 % of the records, municipalities with lower population densities (i.e. small towns) exhibited lower monthly fees and municipalities with higher densities (i.e. cities) exhibited higher monthly fees.

Analysis of the population density and ERU area relationship was performed using Spearman's *ρ* as well. Computations yielded a Spearman's *ρ* of -0.27, indicating that population density is negatively correlated to ERU Area for 27 percent of the records. In other words, for 27% of the municipalities, higher values of population density led to lower values of ERU area. This reveals that for 27% of the records, residential properties have less impervious area in densely populated cities than the residential properties in smaller towns.

3.4.3 The Impact of Home Value

The impact of home value was observed by using the same type of analysis performed for population density (e.g. home value by fee type, monthly rate, and ERU area). Analysis of home value by fee type yielded a number of significant median home value differences. The greatest significant differences, with p-values less than 0.0001, were detected between ERU and Dual, REF and Dual, and REF and Flat Fee systems.

Figure 3.6 depicts a boxplot of the home values categorized by fee type. Here, the significant differences between the median home values of ERU and Dual, REF and Dual, and REF and Flat Fee systems are confirmed. Visual and statistical analysis indicate that Dual and Flat Fee systems may be employed more often in municipalities that exhibit lower home values. ERU and REF systems may be employed more often in municipalities with higher home values.

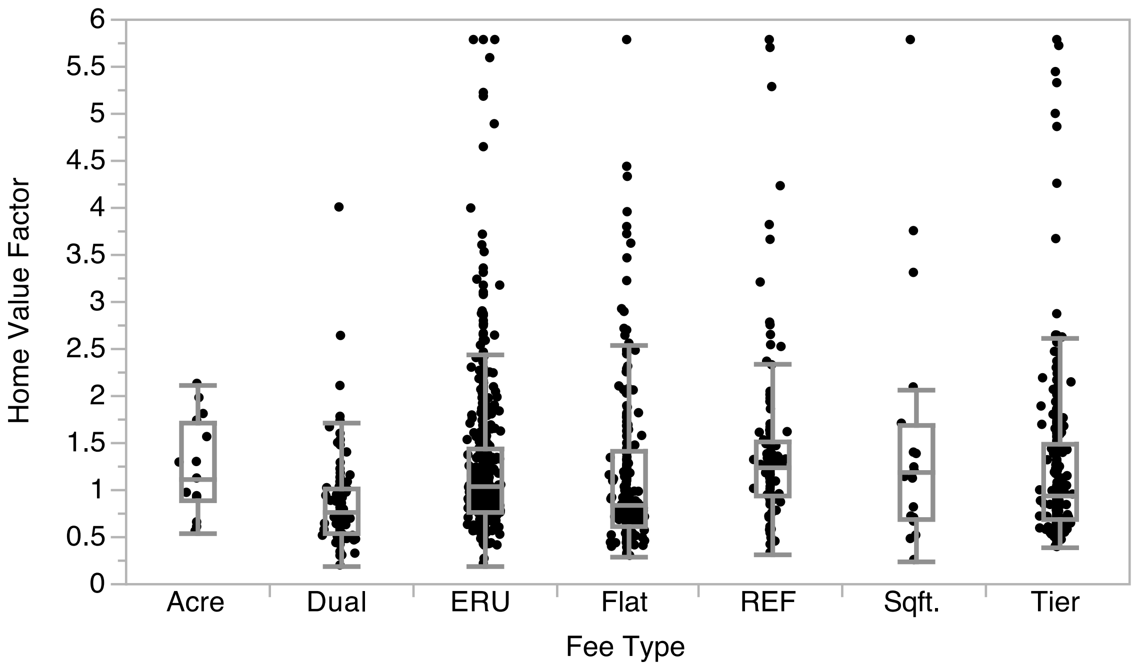

Figure 3.6: Boxplot of Home Value Categorized by Fee Type where Home Value was Normalized Nationally

Examination of home value vs. monthly fee yielded a Spearman's ρ of 0.28, indicating that as median home value (normalized nationally) increased, monthly fee increased for 28% of the municipalities in the database. In these instances of prediction, higher median home values led to higher monthly fees.

Observation of the relationship between the home value factor and ERU area showed no correlation between the two. Figure 3.7 depicts a scatterplot for home value factor vs. ERU area. The plot displays ERU area on the y-axis and home value on the x-axis. It excludes extreme outliers, includes records with ERU fee types only (n= 660), and provides a density ellipse for reference. Figure 3.7 shows no clear trend between home value and ERU area.

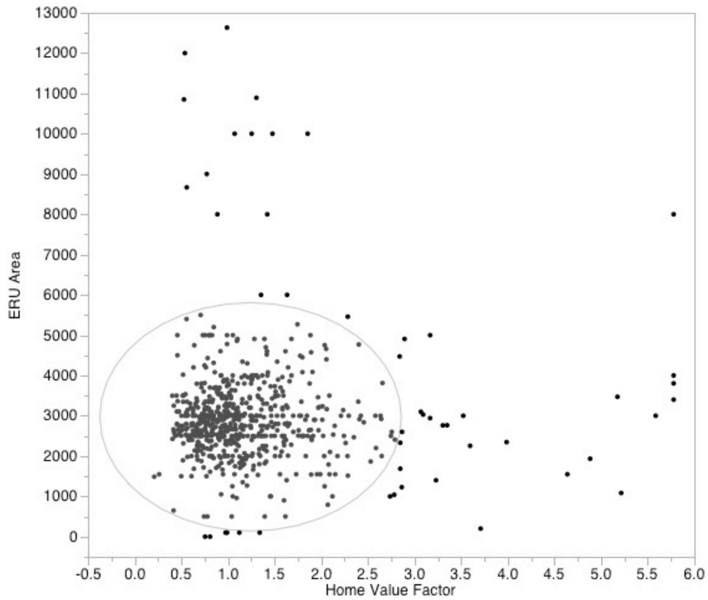

Figure 3.7: Home Value vs. ERU Area

3.4.4 Combined Impact

Geographic location, population density, and home value all effected SUF characteristics when independently analyzed however, it was uncertain what impact these factors would have when combined. To determine the relevance of combining these effects, tests for correlation were performed on population density and home value vs. monthly fee for (1) user fees within each climate region and (2) user fees for each fee type. These tests yielded stronger correlations between population density and home value vs. monthly fee for select climate regions and fee types than the correlations found when the entire dataset was analyzed.

The correlations between population density and monthly fee were stronger for user fees within the East North Central and Southeast regions and user fees classified as Dual systems. Computations yielded Spearman's ρ values of 0.33, 0.25, and 0.36, respectively. Thus indicating that for 33% of the East North Central region records, 25 % of the Southeast region records, and 36% of the Dual user fees, as population density increased, so did the monthly fee.

The correlations between home value and monthly fee were stronger for user fees within the Northwest region and user fees classified as ERU and Tier systems. Computations yielded Spearman's ρ values of 0.42, 0.33, and 0.29, respectively. Thus indicating that for 42% of the Northwest region records, 33% of the ERU systems, and 29% of the Tier Systems, as home value increased, so did monthly fee.

3.4.5 The Impact of Legislation and Regulations

Time series analysis was performed separately for municipalities with Phase I MS4 permits and municipalities with Phase II MS4 Permits. Each analysis computed the proportion of user fees established within a given year. These proportions were then plotted as a timeline against their corresponding years and the years of major stormwater legislation implementation (Figure 3.8 & Figure 3.9). The Water Quality Act of 1987 (WQA87), Phase I large MS4 permit deadline, Phase I medium MS4 permit deadline, Phase II Small MS4 deadline, and Phase II Small MS4 permit renewal dates were all utilized in the analysis and are denoted on the x-axis by dashed lines. Both figures display varying establishment magnitudes in the years surrounding major stormwater legislation implementation.

The analysis of the establishment of user fee programs in municipalities with Phase I MS4 permits showed several trends (Figure 3.8). Rates of establishment were noticeably higher in the years directly before and after the Phase I Large and Medium MS4 permit deadlines and the Phase II Small MS4 permit deadline. A high percentage of user fee establishment, approximately 15% of the 173 records utilized, occurred in the two years following the Phase I MS4 permit deadlines (1993-1994). During the two years following the Phase II Small MS4 Permit deadline, 2004 to 2005, 10% were established. The analysis of the establishment of user fee programs in municipalities with Phase II MS4 permits showed similar trends.

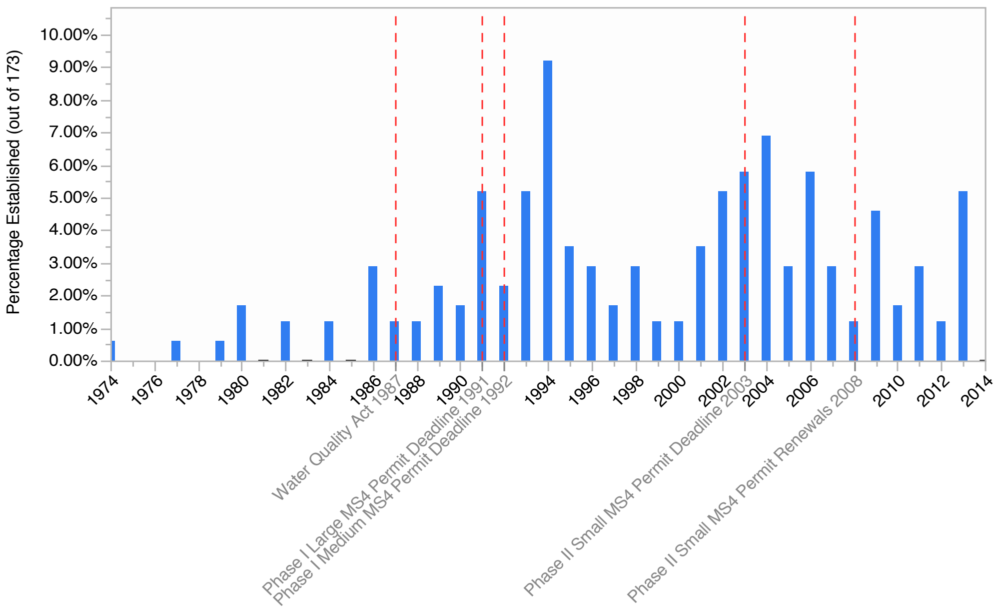

Figure 3.8: Phase I MS4 Establishment Timeline

Phase II MS4 user fee analysis (Figure 3.9) yielded an overall gradual increase in the rate of stormwater user fee establishment. User fee establishment percentages saw increases before and after all years where major stormwater legislation was passed. In the two years following the Phase I Medium MS4 permit deadline, 1993-1994, 7.5% of the stormwater user fees in Phase II municipalities were established. From 2004-2005, 14% were established. Approximately 52% were established from two years before the Phase II Small MS4 permit deadline to two years after the Phase II Small MS4 permit renewal deadline (2001-2010).

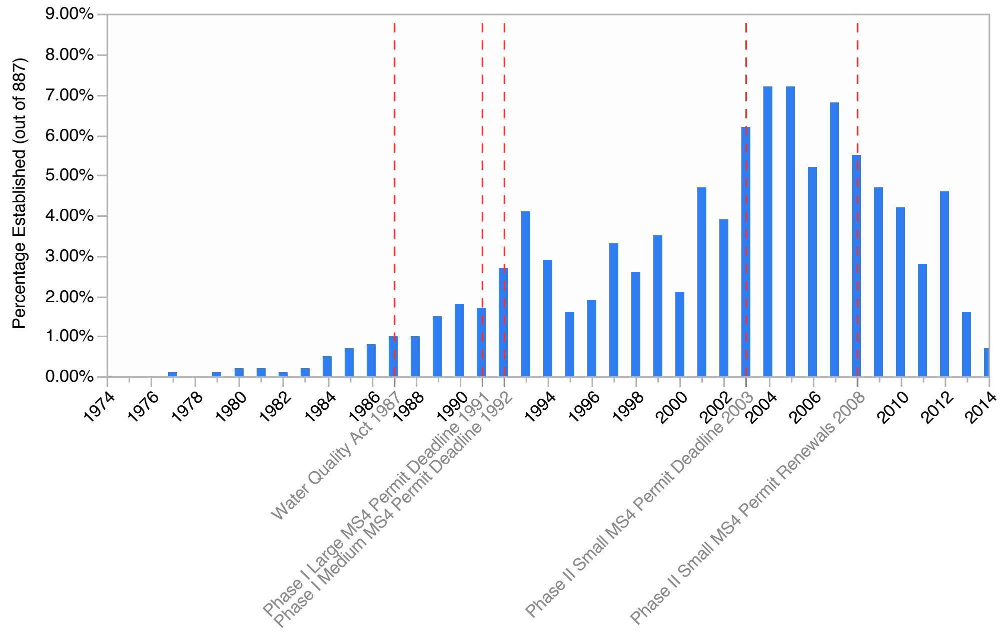

Figure 3.9: Phase II MS4 Establishment Timeline

3.4.6 Conclusions

This research analyzed the impact of spatial location, population density, home value, and legislative impacts on stormwater user fee (SUF) type, magnitude, and establishment. Overall, population density, home value, and location significantly influenced fee type and magnitude while legislation and regulation deadlines proved to play a role in establishment.

From a spatial viewpoint, the ERU was found in all areas and is the most popular in the Central, East North Central, Northeast, Northwest, South, Southeast, and Southwest regions. Tier and Flat Fees were also found in all areas. Tiers are the second most popular in the Central, Northwest, South, Southeast, Southwest, and West regions. Flat fees are the third most popular in the Central, East North Central, Northwest, South, Southeast and Southwest regions.

From a population viewpoint, the ERU was found in municipalities with higher population densities. The Flat Fee was found in municipalities with lower population densities. Higher population densities also led to higher monthly fees for 21% of municipalities.

From a home value viewpoint, the REF method was most popular in municipalities with the highest home values. The ERU was popular in municipalities with higher home values and the flat fee was popular in municipalities with lower home values. Higher home values also led to higher monthly fees for 28% of municipalities.

A number of additional general and statistical observations for fee type, monthly rate, and establishment trends were made. All observations were compiled to aid municipalities in the establishment of an appropriate SUF system and are listed in Tables 3.8-3.12. It is suggested that municipalities consider these observations in conjunction with knowledge of local legal climate and SWMP funding needs to create a SUF.

Table 3.8: 2014 State Prevalent Fee Types and Monthly Rate Ranges

State (n) (1476*)	Most Common	Monthly Rate Range	Second Most Common	Monthly Rate Range
AL (2)	Flat Fee	$3.00	N/A	N/A
AR (1)	Dual	$3.00	N/A	N/A
AZ (3)	ERU	$2.90	Tier	$3.90
CA (56)	Flat Fee	$1.00-$8.66	Tier	$0.48-$12.30
CO (35)	Per Sqft.	$1.39-$13.05	Tier	$0.31-$9.10
DE (2)	Flat Fee	$5.00	Tier	$7.17
FL (178)	ERU	$1.20-$35.00	Flat Fee/Tier	$0.75-$9.58/$1.13-$10.60
GA (53)	ERU	$0.35-$5.86	Tier	$2.50-$4.25
IA (86)	Flat Fee	$0.50-$7.50	ERU	$2.00-$10.95
ID (1)	ERU	$4.00	N/A	N/A
IL (22)	Tier	$2.00-$10.55	ERU	$3.43-$21.83
IN (72)	ERU	$1.25-$9.46	Flat Fee	$2.08-$12.40
KS (34)	ERU	$2.00-$7.50	Tier	$1.18-$20.83
KY (11)	ERU	$3.00-$7.28	Dual	$1.50-$4.00
MA(7)	Flat Fee	$4.42-$5.00	Dual/ERU	$2.08-$3.33/$8.33-$11.67
MD (15)	ERU	$1.74-$$8.30	Dual	$4.16
ME (4)	ERU	$1.83-$7.54	Dual	$4.17
MI (7)	Tier	$3.45-$18.11	Dual	$2.00-$7.05
MN (163)	REF	$0.67-$19.43	Flat Fee	$1.25-$10.21
MO (4)	ERU	$0.50-$3.00	Tier	$1.35
MT (6)	Flat Fee	$2.69-$8.00	ERU	$1.84
NC (70)	ERU	$1.00-$6.93	Tier	$1.50-$30.00
ND (3)	Flat Fee	$2.60-$2.90	N/A	N/A
NM (1)	Tier	$3.00	N/A	N/A
NV (2)	Flat Fee	$4.38	Dual	$8.32
OH (99)	ERU	$0.30-$13.00	Tier	$1.00-$10.80
OK (19)	ERU	$0.75-$5.43	Dual	$2.00-$4.15
OR (51)	ERU	$1.00-$11.76	Tier	$1.50-$14.89
PA (6)	ERU	$6.67-$8.00	Tier	$2.42-$11.61
SC (35)	ERU	$1.80-$9.06	Flat Fee	$2.00-$4.00
SD (3)	N/A	N/A	N/A	N/A
TN (22)	ERU	$1.00-$9.60	Dual	$1.50-$4.00
TX (103)	ERU	$1.00-$9.20	Tier	$0.83-$8.50
UT (35)	ERU	$2.00-$8.71	Flat Fee	$3.00-$6.25
VA (21)	ERU	$0.30-$12.99	Tier	$3.18-$4.00
VT (2)	Tier	$4.50-$5.94	N/A	N/A
WA (113)	ERU	$1.00-$19.67	Tier	$1.50-$15.92
WI (120)	ERU	$1.08-$10.00	Flat Fee	$1.50-$9.39
WV (9)	Dual	$1.50-$5.88	N/A	N/A

*Excludes repealed user fees (*n*= 13) and user fees with unique fee types (*n*=1).

Table 3.9: 2014 Prevalent Fee Type Based on Population and Monthly Rate Range

Level (1476*)	Population Density Range	Most Common	Monthly Rate Range	Median Monthly Rate	Second Most Common	Monthly Rate Range	Median Monthly Rate
4 (344)	0-7,145	ERU	$01.20-$19.10	$3.98	Flat Fee	$0.50-$18.18	$3.00
3 (378)	7,146-18,486	ERU	$0.09-$21.83	$4.00	Flat Fee	$0.75-$8.78	$4.00
2 (377)	18,487-49,405	ERU	$1.00-$22.00	$4.33	Tier	$1.00-$15.92	$4.10
1 (377)	49,406-3,792,621	ERU	$0.30-$17.82	$4.94	Tier	$0.31-$21.78	$4.25

*Excludes repealed user fees (*n*= 13) and user fees with unique fee types (*n*=1).

Table 3.10: 2014 Prevalent Fee Type Based on Median Home Value and Monthly Rate Range

Level (1454*)	Home Value Range	Most Common	Monthly Rate Range	Median Monthly Rate	Second Most Common	Monthly Rate Range	Median Monthly Rate
4 (362)	$23,400-$125,500	ERU	$1.00-$10.95	$3.50	Flat Fee	$0.24-$12.40	$3.00
3 (365)	$125,501-$175,400	ERU	$0.30-$12.92	$4.00	Tier	$1.35-$12.10	$4.00
2 (363)	$175,401-$253,300	ERU	$0.35-$19.10	$4.50	REF	$0.67-$19.43	$3.95
1 (364)	$253,301-$1,000,001	ERU	$1.20-$35.00	$5.80	Tier	$0.48-$21.50	$6.25

*Excludes user fees for which municipality median home value was not found (*n*=36).

Table 3.11: 2014 Prevalent Fee Type by NOAA Climate Region and Monthly Rate Range

Region (*n*)	Most Common	Monthly Rate Range	Second Most Common	Monthly Rate Range
East North Central (377)	ERU	$12.92-$0.75	REF	$19.43-$0.67
Southeast (363)	ERU	$14.15-$0.09	Tier	$18.11-1.13
Central (241)	ERU	$21.83-$0.30	Tier	$10.60-$0.95
Northwest (168)	ERU	$22.01-$1.00	Tier	$21.00-$1.30
South (157)	ERU	$19.00-$1.00	Tier	$20.83-$0.83
Southwest (76)	ERU	$9.25-$1.98	Tier	$9.10-$0.31
West (58)	ERU	$8.77-$1.20	Tier	$12.78-$0.48
Northeast (38)	ERU	$11.67-$1.74	Tier/Flat Fee	$21.78- $2.00 /$13.48-$0.01
West North Central (12)	Flat Fee	$8.00-$2.60	ERU	$16.67-$1.84

Table 3.12: 2014 SUF Type, Magnitude, and Timeline Statistically Significant Observations

Fee Type	Statistically Significant Observations
	1. ERU systems are prevalent in municipalities with higher population density. 2. Flat Fee systems are present in municipalities with lower population density. 3. REF systems are located in municipalities with higher population density. 4. Tier Systems are prevalent in municipalities with higher population density. 5. Dual and Flat Fee systems occur more often in municipalities with lower home values. 6. ERU systems are more prevalent in municipalities with higher home values. 7. REF systems are more prevalent in municipalities with higher home values than ERU municipalities.
Monthly Fee	1. For 21% of municipalities, as population density increases, monthly fee increases. 2. For 28% of municipalities, higher home value factors lead to higher monthly fees. 3. For 33% of ERUs and 30% of TIER systems, higher home values lead to higher monthly fees. 4. Overall, municipalities in the Northwest Region have the highest SUF monthly rates. 5. Municipalities in the South region have lower monthly SUF rates.
ERU Area	1. For 27% of municipalities, as population density decreases, ERU area decreases. Therefore, 27% of municipalities with higher population densities have smaller ERU areas.
Home Value	1. 42% of the municipalities in the Northwest region have higher monthly fees in municipalities with higher home values and lower monthly fees in municipalities with low home values. 2. 25% of municipalities in the East North Central and 26% of municipalities in the Southeast Regions with higher home values have higher monthly fees. 3. All other regions do not have correlation between home value and monthly rate.
Population Density	1. In 32% of the East North Central, 21% of the Northwest, 21% of the South, and 25% of the Southeast region, municipalities with higher population densities have higher monthly rates. 2. All other regions (West, Southwest, Northeast, Central) do not have correlation between population density and monthly rate. 3. Municipalities with higher population density have higher monthly rates for 35% of Dual , 20% of ERU, 20% of REF, and 17% of Flat fee systems.
Legislation and Regulation	1. The establishment of SUFs in municipalities with NPDES Phase II permits steadily increased in the years before and after a major Phase II permit regulatory deadline or renewal year. 2. The establishment of SUFs in municipalities with NPDES Phase I permits peak near Phase I and Phase II permit deadline.

4 Conclusion

4.1 Future Work

Further review and definition of the user fee types is recommended as well as the investigation of the impacts of population, flood frequency, and political issues. Due to the wide variability in user fee systems, many user fee systems were "over" –simplified through the use of the 12 fee type structures assigned. Further elaboration and separation of these fee types will allow for a more detailed analysis among more comparable fee systems. In particular, the Dual, charge per acre, and charge per square foot fee type denotations will benefit from review and expansion.

> The Dual structure fee type is one of the least defined structures in the database. Often, municipalities that employ the ERU method charge residential properties for 1 ERU, otherwise known as a single flat fee. This represents a dual system. However, dual systems were not extensively noted within the SUF database. The charge per acre and charge per square foot fee types are often dual systems that present as charges per parcel area.
>
> The charge per parcel acre and square foot fee types are often complex systems which are not denotable in the current database structure. The database will benefit from expansion to include allocated descriptors for these differences. However, completion of this task may lead to the inability to perform statistical analysis on the newly formed descriptors due to an inadequate number of records.

Better analysis will also result from the acquisition of additional data such as annual or monthly user fee program income and the total contribution of this income to SWMP expenses. Stormwater user fees may be created with the intention of partially or fully funding expenses. Analysis results may vary if performed separately for user fees intended to fully or partially fund expenses.

The database is the largest of its kind, but will benefit from the addition of more stormwater user fee systems. In some cases, the statistical analysis performed was hindered by a low number of records.

Political issues and/or political climate may play a role in SUF establishment, type, and magnitude. Municipalities with liberal or conservative political atmospheres may choose to use certain methods or charge rates based on political decisions. An investigation into the impact of politics on user fees will help broaden the overall understanding of SUF implementation and provide further guidance to municipalities.

In this research, the relationships between population density and SUF characteristics were investigated. However, an analysis of the relationship between population and SUF characteristics is recommended. The "clustering" of fees seen in Figure 3.1, appears to occur in areas of the U.S. that have cities with higher populations. Whereas, areas of the U.S. with less populated municipalities appear to have fewer fees established. Further investigation into the impact of population alone will prove useful and provide a simple guidance parameter for municipalities looking to initiate a stormwater user fee.

Finally, an investigation of municipalities with high risks for floods is recommended. It is expected that trends in SUF establishment and location may be due, in part, to the potential for high peak flows and flood events. These instances can lead to higher stormwater management expenses for a municipality and thus result in the establishment of a SUF or the utilization of select fee types. By investigating SUFs in high-risk flood areas, further guidance can be provided.

4.2 Final Conclusion

This research provides a summation of trends observed from the analysis of a national stormwater user fee database. The conclusions made cannot be applied as "sweeping" observations. However, they do provide insight into factors that exhibit some influence on the fees currently in existence. As more user fees are established, the database is expanded, and new analysis techniques are explored, it is expected that additional analysis will yield promising results. For now, these results provide insight to municipalities into stormwater user fees that was previously unavailable.

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Appendix A: Sample of 2014 SUF Database

This section contains a small excerpt from the stormwater user fee database used in analysis. It does not include all variables.

Community	State	Fee Type	Fee Type Area	Fee Type Comments	ERU (ft2)	Residential Base Fee	Res Base Fee Comment	Residential ERU Fee	Commercial Base Fee	Commercial ERU Fee	Commercial Fee Comments
Jefferson County Stormwater Management Authority	AL	-									
Mobile	AL	F				3.00					
Jefferson County, Unincorp.	AL	F		Fee included on property tax bill, assessed on unincorporated portions of county							
Hot Springs	AR	D				3.00			6.00		
Flagstaff	AZ	T			1500					1.30	
Peoria	AZ	-									
Oro Valley	AZ	E			5000			2.90			
Mesa	AZ	F				7.32					
Stockton	CA	E			2,347			2.10			
Salinas	CA	V									
Burlingame	CA	A		per sqft charge multiplied by average area		10.48					
Davis	CA	A		per sqft charge multiplied by average area				4.83		0.0004	see municipal code for tier levels

Appendix B: Statistical Methods

Chi^2 Test Statistic

$$\chi^2 = \left(\frac{U - {mt}/{N}}{\left[mnt(N-t)/N^3 \right]^{1/2}} \right)^2$$

See (Gibbons and Chakraborti 2011) for further elaboration and definitions of variables. Other, simpler forms of the Chi squared statistic are available.

P Values

The p value represents the probability of the occurrence of a test statistic greater than, less than, and or equal to a given test statistic (Kruopis and Nikulin 2011). It is often used in Hypothesis testing procedures. When the p value is less than a predetermined value, called alpha, the Null Hypothesis, H_o, is rejected. This research utilized an alpha value of 0.05 whenever necessary. Therefore, computed p values below 0.05 yielded a rejection of H_o.

Wilcoxon Test Statistic

$$W = \sum_{i=1}^{m} ic_i$$

Statistic based upon rank of data.

Spearman's ρ Statistic

$$\rho = R = 1 - \frac{6 \sum_{i=1}^{n} D_i^2}{n(n^2 - 1)}$$

Where: n represents the total number of pairs,

$$D_i = (R_i - \bar{R}) - (S_i - \bar{S})$$

R_i= rank (X_i) and S_i = rank (Y_i)

See Gibbons and Chakraborti, 407-409, for full description.

Alternatives to the tests described above exist. These test were chosen for their simplicity and acceptable error. Control methods may be utilized in place on the Wilcoxon test however, type II error will escalate. Therefore, the chance of accepting the null hypothesis when the null should be rejected increases. Differences may not be detected but the differences that are detected will be more definite.

Appendix C: Statistical Analysis Summary Tables

This section contains tables populated with the statistical analysis results obtained from this research. As a reminder, all significance levels were set to 0.5 and 95% confidence intervals were utilized when necessary.

Table C.1: Statistical Analysis Procedures

Analysis	Analysis Type	Tests	Variables Analyzed	*n* (# of records)	D.O.F.	Test Statistic	p value
Geo-spatial	Categorical vs. Categorical	Contingency Table Pearson's Chi Squared	Fee type vs. NOAA Climate Region	1345		Chi^2	<.0001
	Categorical vs. Categorical	Contingency Table Pearson's Chi Squared	Fee type vs. State	1353		Chi^2	<.0001
	Categorical vs. Categorical	Contingency Table Pearson's Chi Squared	Fee Type vs MS4 Permit Type			Chi^2	
Population Density	Categorical vs. Continuous	Median Rank Wilcoxon each pair	Population Density vs. Fee Type	1467 26.085 4	6	Chi^2 = 26.09	<0.0002
	Continuous vs. Continuous	Scatterplot Spearman's *p*	Population Density vs. Monthly Fee	Varies see Table 0.2_			Varies see Table 0.2
	Continuous vs. Continuous	Scatterplot Spearman's *p*	Population Density vs. ERU area	674		*p*= -0.27	<0.0001
Home Value	Categorical vs. Continuous	Median Rank Wilcoxon each pair	Home value by Fee Type	Chi 43.232 0	6	Chi^2 = 43.23	<0.0001
	Categorical vs. Continuous	Median Rank Wilcoxon each pair	Home value vs Monthly Fee	Varies	Varies see Table C.5	Varies see Table C.5	Varies see Table C.5
	Continuous vs. Continuous	Scatterplot Spearman's *p*	Home Value vs ERU Area	660		*p* =-0.027	
Monthly Fee	Categorical vs. Continuous	Median Rank Wilcoxon	Monthly Fee vs Fee Type	1383	6	Chi^2= 24.09	0.0005

Table C.2: Population Density vs. Monthly Fee Analysis Summary

	n	Spearman's p	p value	Reject Ho?	Percent Variation
Overall:	**1352**	**0.2108**	**<0.0001**	**Y**	**0**
Fee Type					
A	15	0.0125	0.9647	N	94.07020873
Dual	83	0.3552	0.001	Y	68.50094877
ERU	675	0.2012	<0.0001	Y	4.55
Flat	216	0.1748	0.0101	Y	17.07
REF	115	0.1954	0.0363	Y	7.30
S	18	0.4076	0.0931	N	93.36
Tier	217	0.2109	0.0018	Y	0.047
Average Percent Variation for by fee type:					19.50
Climate Region					
Central	223	0.1343	0.0452	Y	36.29
East North Central	333	0.3296	<0.0001	Y	56.36
Northeast	29	0.934	0.6299	N	343.07
Northwest	153	0.214	0.0079	Y	1.52
South	151	0.2079	0.0104	Y	1.38
Southeast	339	0.2453	<0.0001	Y	16.37
Southwest	69	0.0402	0.7431	N	80.93
West	46	-0.1169	0.4392	N	155.46
West North Central	9	n/a	n/a		
Average Percent Variation for by Climate Region:					22.38

Table C.3: Monthly Fee by NOAA Climate Region Significant Differences

Grouping		Test Statistic Values	
Fee Type	Fee Type	Z	P Value
NW	ENC	7.77	<0.0001
NW	C	7.96	<0.0001
SE	S	3.04	0.0023
SE	C	2.21	0.027
NW	NE	2.71	0.0066
SW	C	2.22	0.0262
SW	S	2.70	0.0069
W	SW	-2.32	0.0199
WNC	SE	-0.35	0.0199
S	ENC	-2.41	0.0442
SW	NW	-4.42	<0.001
W	SE	-2.41	<0.001
W	NW	-4.84	<0.001
S	NW	-7.66	<0.001
SE	NW	-7.32	<0.001

Table C.4: Summary of Significant Differences between Home Value vs Fee Type

Home Value (National) vs. Fee Type Significant Differences			
Grouping			
Fee Type	Fee Type	Z	P Value
ERU	Dual System	5.77	<0.0001
REF	ERU	3.42	0.0006
REF	Dual System	6.58	<0.0001
REF	Flat Fee	4.82	<0.0001
Tier System	Dual System	3.94	<0.0001
Flat Fee	Dual System	2.51	0.012
Charge per Sqft.	Dual System	2.51	0.0119
Tier System	REF	-3.59	0.0003
Flat Fee	ERU	-3.65	0.0003

Table C.5: Home Value vs. Monthly Fee Analysis

	n	Spearman's p	p value	Reject Ho?	Percent Variation
Overall:	**1311**	**0.2810**	**<0.0001**	**Y**	**0**
Fee Type					
A	15	-0.01126	0.6895	N	104.01
Dual	83	0.1053	0.3403	N	62.53
ERU	675	0.3373	<0.0001	Y	20.04
Flat	216	0.1858	0.0065	Y	33.88
REF	115	0.1486	0.1179	N	47.12
S	18	0.4902	0.0458	Y	74.45
Tier	217	0.2944	<0.0001	Y	4.77
Average Percent Variation for by fee type:					33.28
Climate Region					
Central	215	0.0336	0.6241	N	88.04
East North Central	329	0.2538	<0.0001	Y	9.67
Northeast	27	-0.168	0.4023	N	159.78
Northwest	149	0.4209	<0.0001	Y	49.78
South	147	0.2351	0.0042	Y	16.33
Southeast	333	0.2624	<0.0001	Y	6.61
Southwest	68	0.1565	0.2026	N	44.30
West	34	-0.1435	0.4181	N	151.06
West North Central	9	n/a	n/a		
Average Percent Variation for by Climate Region:					20.60

Appendix D Additional Figures

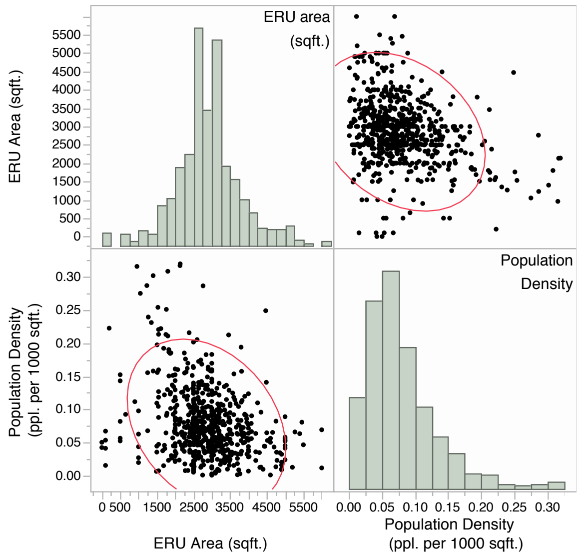

Figure D.1: ERU Area vs. Population Density Scatterplot

The provided plot excludes extreme outliers (*n* = 674), includes records with ERU fee types only, and depicts histograms and density ellipses for reference.

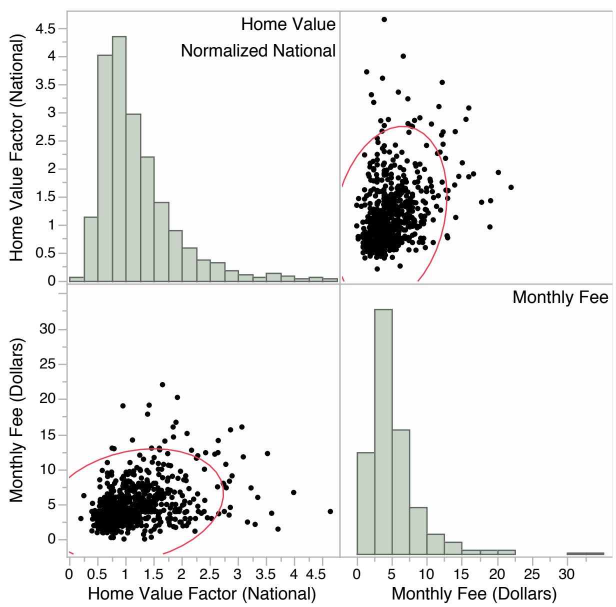

Figure D.2: Home Value vs. Monthly Fee Scatterplot

The provided plot excludes outliers (*n*= 1,311) and provides density ellipses and histograms for reference.

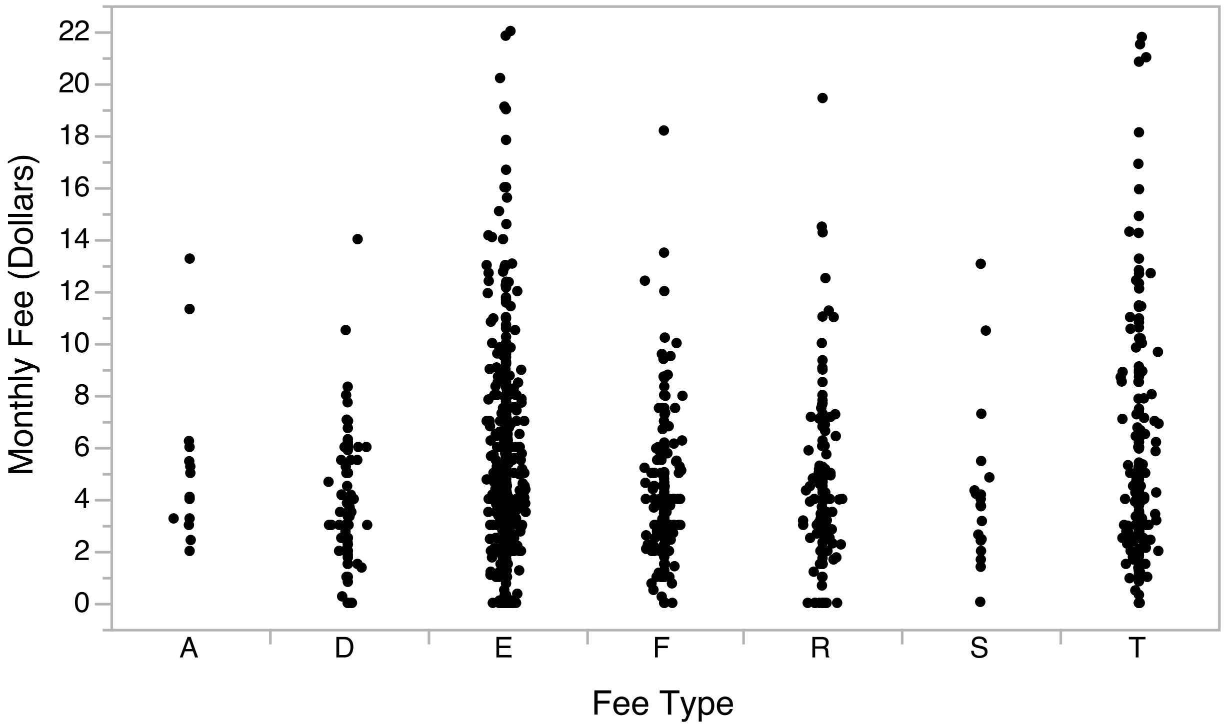

Figure D.3: Monthly Fee by Fee Type

The provided scatterplot displays the variance of the data used in observing the relationship between fee type and monthly fee.