TOWN OF HIGHLAND PARK, TEXAS: ASSESSMENT OF WATER USE AND CONSERVATION POTENTIAL

The Meadows Center for Water and the Environment
Report: 2019-04
June 2019

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Jaime P. Murata, M.A.Geo.

The Meadows Center
for Water and the Environment
Texas State University

MEMBER **THE TEXAS STATE UNIVERSITY SYSTEM**

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INTRODUCTION

The Town of Highland Park (THP), Texas (Figure 1) and the Meadows Center for Water and the Environment at Texas State University (TSU) began a nine-month project on October 1, 2018 to explore water use and conservation potential within the THP. A key component of the project is to have engaged a graduate student "intern" as part of the TSU team. This individual, Ms. Jaime P. Murata, will use the work performed on addressing three of the four project goals as her directed research, a requirement of the Master in Applied Geography (MAGeo) degree program. Dr. Tim Loftus, Ms. Murata's advisor, will lead the TSU team.

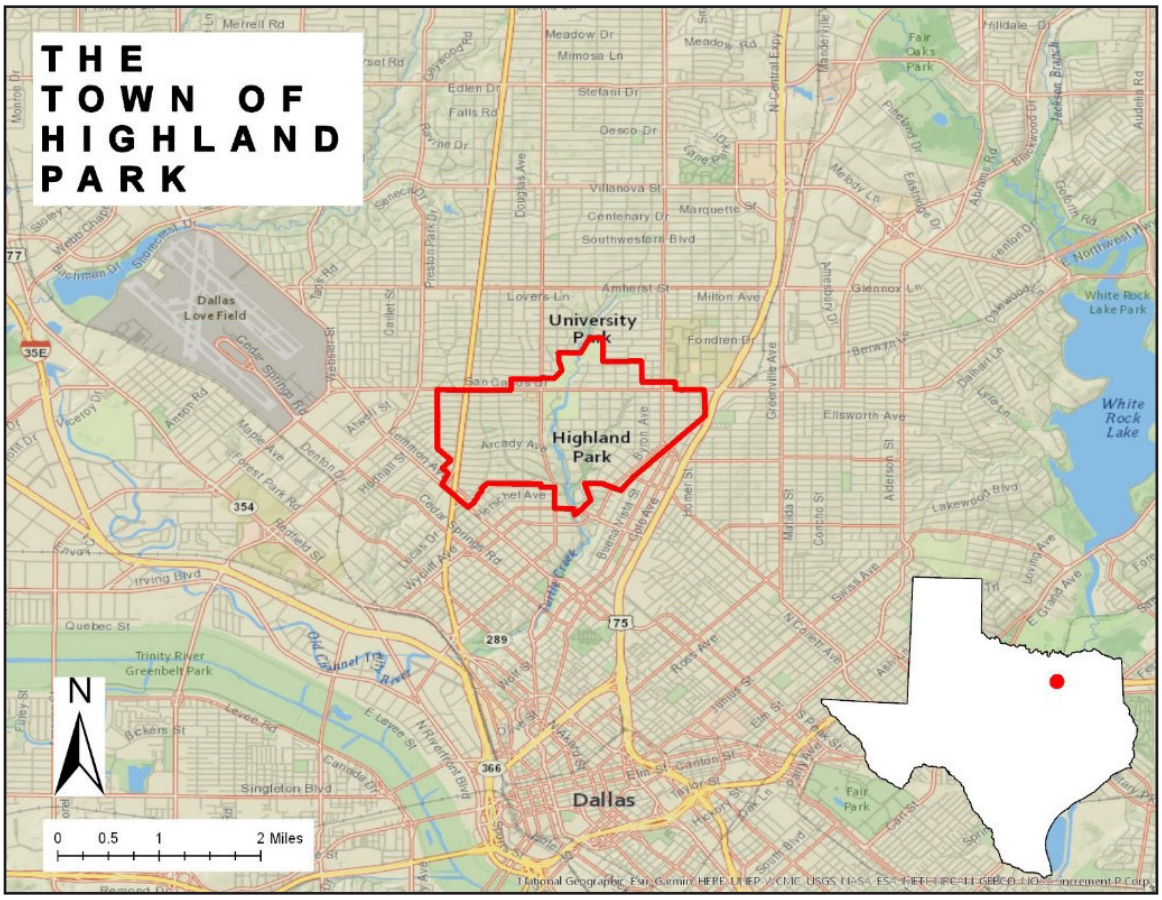

Figure 1. Location of the Town of Highland Park, Texas.

In general, the THP wishes to build on current water-use conservation efforts and by doing so, reduce relatively high per capita water use. A recent investment in automatic meter infrastructure and complementary WaterSmart software positions the THP with state-of-the-art technology to better understand real-time water use, change through time, and potential trends that might emerge among their five meter-class accounts. Information from data analysis will help inform efforts to communicate with ratepayers, tailor conservation measures, and develop and manage a robust water-conservation program.

The project scope-of-work entails four goals:

1. Gather information about Best Management Practices (BMPs) applied to city- and town-owned properties for the purpose of conserving water from the following cities in Texas: Alamo Heights, Irving, Southlake, The Woodlands, West University Place, Westlake, and Westover Hills. Similar information was also gathered from Cary, North Carolina, Santa Fe, New Mexico, and Scottsdale, Arizona;

2. Improve the THP score as determined by the Texas Living Waters Project, Texas Water Conservation Scorecard (2016) where the THP did not capture all available points;

3. Analyze WaterSmart-derived data to create new information that enables the THP to promote water-use conservation; and

4. Explore the extent to which water conservation-oriented curriculum or activities is or can be incorporated in the classrooms of the Highland Park Independent School District (HPISD).

Why is water conservation and the THP stewardship both necessary and important? Everyone lives in a watershed. The bays and estuaries that largely define the Texas Gulf Coast, depend on ample freshwater inflows to protect fragile ecosystems and sustain commercial-fishery and recreational industries that are major components of the Texan identity and economy. Galveston Bay, for example, depends on the Trinity River for ecosystem and economic sustenance. Upstream cities and towns, like the Town of Highland Park, have an obligation, therefore, to support the ecosystem and economic health of Texan bays and estuaries. Thus, the stewardship that is necessary means being very conservative with the water that is used and removed from the life-giving Trinity River Watershed (Figure 2).[1]

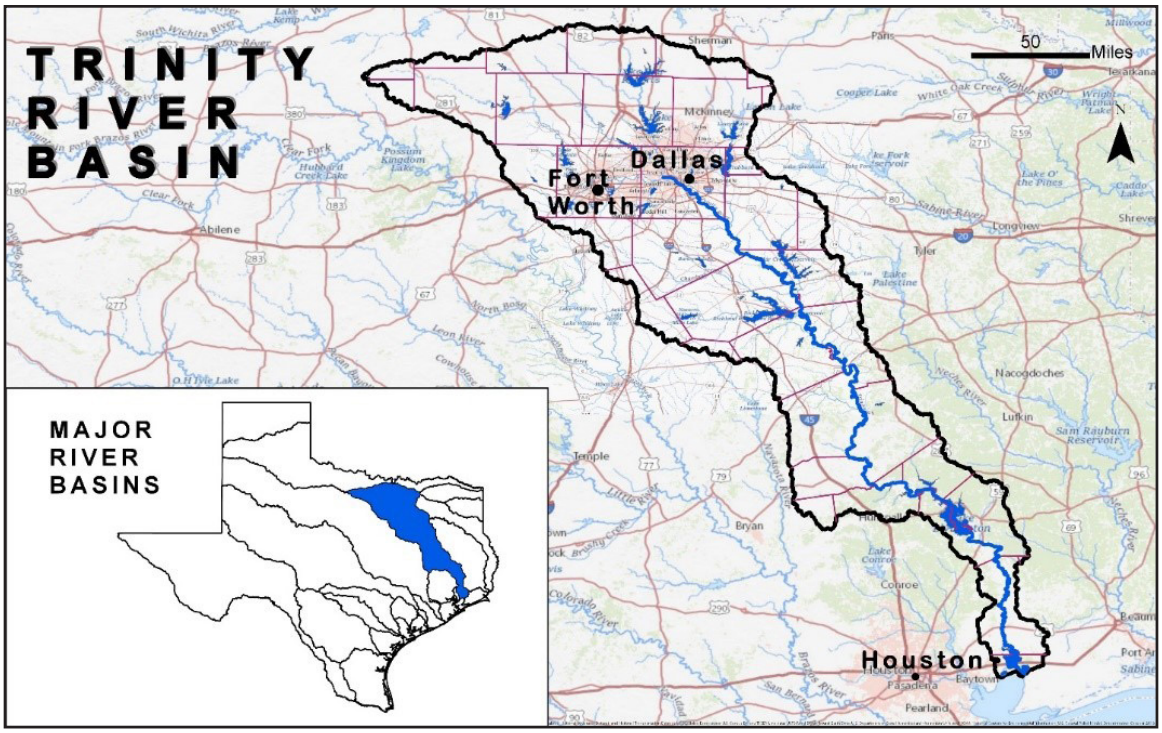

Figure 2. The Trinity River Watershed, one of Texas' largest river basins, reaches from north of Dallas to Galveston Bay.

[1] Large watersheds are often referred to as river basins. The Trinity River Watershed, therefore, is the same area as the Trinity River Basin.

EXECUTIVE SUMMARY OF FINDINGS

Goal #1

Ten cities were selected or approved by the THP executive staff for investigation of their Best Management Practices (BMPs) related to municipal properties (Table 1; Appendix A). The TSU team developed a list of interview questions to determine how each city minimizes watering of their properties and how water conservation is promoted to the public and to local school districts. The TSU team posed five questions in telephone interviews with each city.[2] Additional research using the information available on municipal websites was then conducted on the cities' water rates/structures, outdoor-watering ordinances, and public awareness efforts.

Table 1. Peer cities from Texas and elsewhere for limited comparison of water-use practices.

1	City of Alamo Heights, TX
2	City of Irving, TX
3	City of Southlake, TX
4	City of West University Place, TX
5	Town of Westlake, TX
6	Town of Westover Hills, TX
7	The Woodlands CDP, TX
8	Town of Cary, NC
9	City of Santa Fe, NM
10	City of Scottsdale, AZ

City Property Management

The following are responses to two questions: "Does your town/city manage any of their properties as best practices or demonstration projects for your residents in terms of minimizing water use?" and "How often do you specify native or regionally-appropriate plants for purposes of minimizing watering requirements?" Of the water conservation strategies implemented by the 10 cities for their own property management, seven use native or regionally-appropriate plants. As for irrigation, four do not (or barely) irrigate, four irrigate with reused water or captured rainwater, and two use artificial turf for sports fields. Put another way, very little potable water is applied to peer-city-managed landscapes. Also, seasonal time-of-day watering schedules are used by Irving, Santa Fe, and West University Place. West University Place also utilizes rain sensors to help prevent overwatering.

Coordination between City and Local ISD

In response to the question, "Thinking about promoting water conservation, what level of coordination occurs between the public works department and the local school district?", the interviewees provided answers as follows. Five of the eight cities with public schools encourage water conservation through education by participating in career fairs at local schools or hosting conservation-related annual events for school-aged children. Other cities' efforts include classroom presentations and field trips. The City of Santa Fe, New Mexico provides an outstanding example of coordination with the local school district by hosting an Annual Children's Water Conservation Poster Contest, a Passport Program to 14 classes with a field trip of the water system and the city's water recycling, a Water Fiesta for all 4th graders, and by taking part in Project WET (Water Education for Teachers) to help teachers incorporate water education in elementary and middle-school curricula.

[2] A majority of interviewees could not answer the question, "how many acres or parcels of land are managed by the city?" and the question/responses, therefore, were omitted from this summary.

Water Consumption: GPCDs

The last interview question was "What is your city's current total GPCD (gallons per capita per day) and residential GPCD?" It was discovered that the THP's residential and total GPCDs are higher than seven of the nine cities that have available GPCD data (Figure 1). The town with the lowest GPCD is the Town of Cary, North Carolina with a 46 residential GPCD and an 83 total GPCD in year 2018. Most cities studied have lower GPCDs than the THP with both Westlake and Westover Hills exceeding the THP's GPCDs.

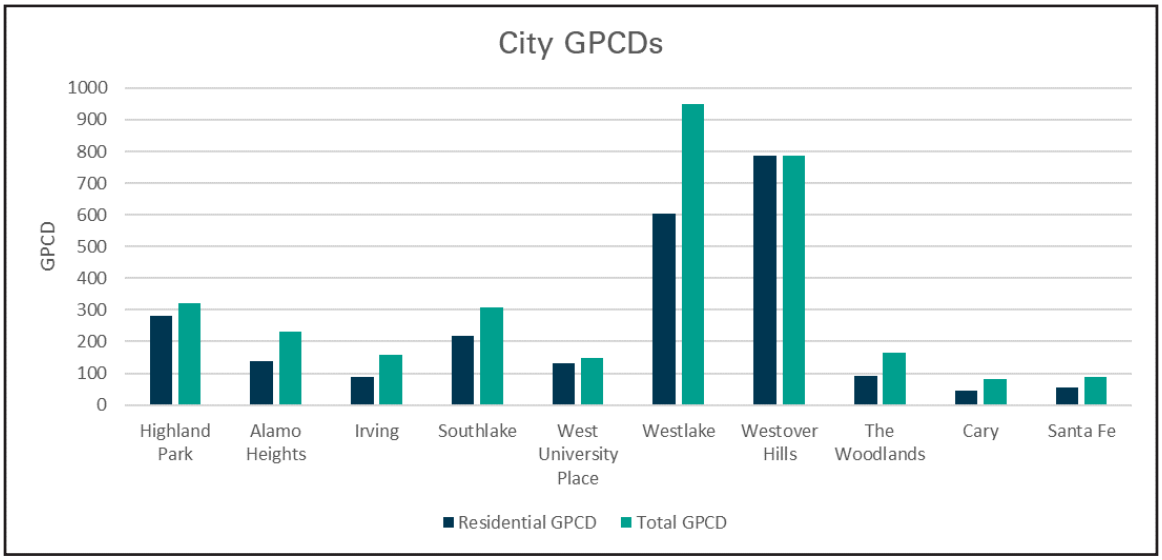

Figure 3. Comparison of total and residential water consumption: gallons per capita per day (GPCD). [3,4]

Public Awareness/Campaign

To promote public awareness, a water-conservation campaign that features a memorable slogan along with substantive information and guidance, is a good start and four of the cities have taken this initiative: Irving; Santa Fe, NM; Southlake; and The Woodlands. All ten cities and the THP use their city's website to promote water conservation with aspects from landscaping tips, blogs, educational videos, and links to other water-wise resources. The City of Irving has success passing out the Texas A&M AgriLife Extension's Top 100 Plants for North Texas Deck of Cards at events to promote water efficient landscapes. They also have a City Green Advisory Board to advise the City Council on "green" initiatives. Southlake, The Woodlands, and Scottsdale, Arizona advocate conservation through their demonstration gardens. The Woodlands and Cary, North Carolina encourage residential leadership through neighborhood competitions and block leader programs.

Outdoor-Watering Restrictions

Seven out of 10 of the cities have time-of-day watering restrictions, like the THP, but The Woodlands has exceeded these by forbidding watering from 6am to 8pm, year-round. While the THP's restriction is only seasonal, five of the cities implement a time-of-day ordinance that is year-round to encourage a continuous water-conservation mindset. The THP currently matches the number-of-watering-days restriction of 5 of 10 cities by limiting watering to two days per week. Yet research conducted elsewhere shows that it is common for homeowners to irrigate their residential landscapes much more than necessary.[5]

[3] Scottsdale, AZ was omitted from Figure 1 because insufficient data were supplied for determining their GPCDs.

[4] While the 2017 Water Use Surveys were used to calculate GPCD, different population estimates can be found elsewhere and thus, the population and related GPCDs are best considered provisional.

[5] See, for example, the Texas Water Journal, Vol. 6, No. 1 (2015), "Residential outdoor water use in one East Texas community" by T.R. Pannkuk and L.A. Wolfskill.

The Texas A&M AgriLife Extension WaterMyYard.org web-based resource, for example, indicates that for the week of June 17 to Sunday, June 23, 2019 at the address – 4700 Drexel Drive, Highland Park, Texas – zero inches of water is needed and thus, recommends "No watering required!" In other words, based on recent weather, no outdoor watering is necessary for this seven-day period. Watering requirements are updated weekly. This resource offers an alternate approach to timer- or rain sensor-based irrigation controllers for more efficient use of potable water.

Water Rates/Rate Structures

The THP's water rates come out relatively average compared to the 10 cities studied. Their base charge of $17.41 is much less than the potential shown in Westlake's base charge of $50.40. High rates within the first tier of a multitiered water-rate structure is a strategy to promote conservation from the start which Southlake exemplifies with a first-tier rate of $40.58/1,000 gallons up to 2,000 gallons.[6] Higher prices in the second tier to encourage conservation with discretionary water use is another strategy applied by Santa Fe where the charge is $21.72/1,000 gallons for usage above 7,000 gallons of use during the drier months of the year.[7] While the THP's four tiers is the most common number of tiers in this comparison (7 of 10 cities), the size of the tiers is equally important for incentivizing conservation. All but one of the nine cities that have tiered water-rate structures have a smaller or narrower first tier range than the THP which is 0-12,000 gallons. The cost for a residential ratepayer to use 8,000 gallons in one month[8] in the THP is $61.25, but four cities in our comparison have a higher price for that amount of consumption (Figure 2). Three of these four cities are located in Texas with similar affluence to the THP, while many of the five cities that have lower water-bill charges than the THP are in wetter climates where scarcity potential is lower. Southlake has the highest cost for 8,000 gallons consumption at $108.34.[9]

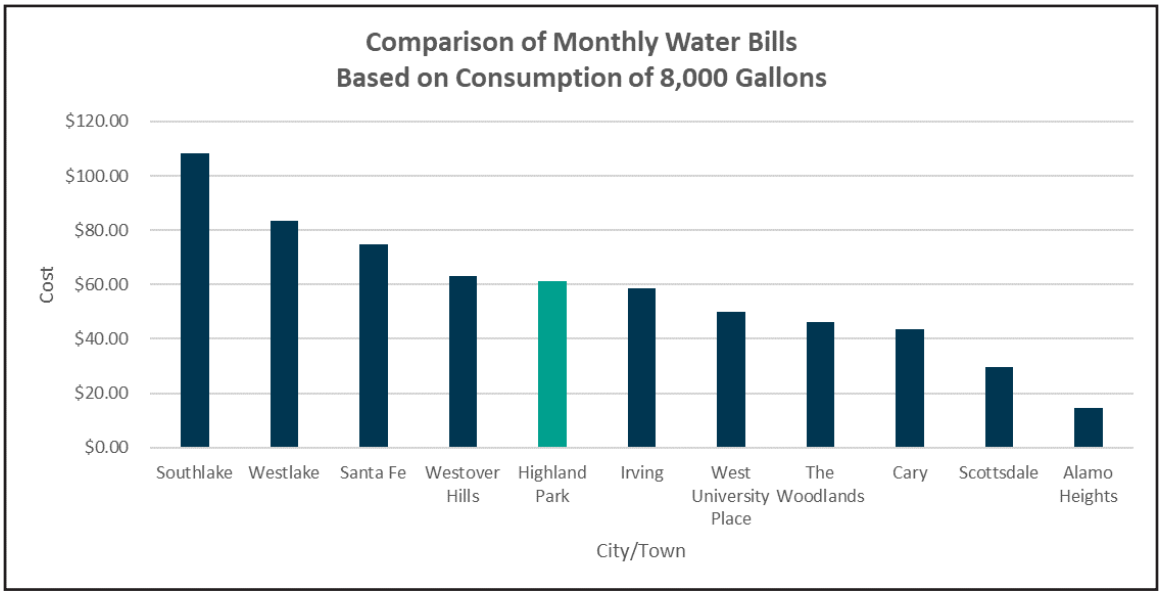

Figure 4. Comparison of residential water bills based on average monthly consumption.[10]

[6] Alternate strategies, depending on the socio-economic demographics of a municipality, keep the first-tier rate relatively low in order to make essential water use, affordable.

[7] The City of Santa Fe, New Mexico has two seasonal water rates/rate structures: May-August (not-so-dry season) and September-April (dry season).

[8] Average monthly consumption is based on 2.84 persons per household in Texas (US Census Bureau 2017) and 94 gallons per capita per day consumption (single-family residential, statewide average) derived from Mace and Hermitte (2012).

[9] While not one of the cities evaluated, the City of Austin, known for its water conservation program, has a rate structure that places monthly water usage above 11,000 gallons in a fourth tier priced at $12.70/1,000 gallons. Low-income residents that participate in the Community Assistance Program will pay $11.51/1,000 gallons for usage above 11,000 gallons. Austin Water's water-rate structure features five price tiers. For more information, see https://www.austintexas.gov/sites/default/files/files/Water/Rates/ResidentialPublicRates_2019.pdf.

[10] The City of Santa Fe, New Mexico has two seasonal water rates where the higher rate applies during the longer dry season. The water bill featured here is an average of the two rates.

Goal #2

A more detailed report and accompanying MS-Excel file on this project goal was submitted to the THP on March 31, 2019 via email. Here we summarize that a conservation program scenario featuring ten indoor-conservation measures for both residential and commercial/institutional water-use sectors estimated annual water savings by year 2035 that will supplant eight percent of the forecast-baseline demand equaling annual savings of 346 acre-feet. The Net Present Value of this scenario is estimated to be $1,789,717 with a benefit-cost ratio of 2.4 after full execution of the program. By year 2035, the retail water rate will need to be 5.4 percent higher than the rate scheduled for that year to pay for the conservation program. This increase does not include the cost of employing a new part- or full-time conservation coordinator.

Outdoor water conservation measures depend on data that is currently missing for the THP. For example, the conservation planning tool used by the TSU team requires average landscape area per lot and average turf area per lot. The THP will have to first determine two-four average residential lot sizes for which these datapoints can be estimated. Since most water savings are likely to come from outdoor water-use reductions, this is an important data development need.

Employing the measures included in the conservation program scenario, along with a needed update to the BMP conservation activity list included in the TWDB's Water Conservation Plan Annual Report, should result in an improved score on the Texas Living Waters Conservation Scorecard.

Goal #3

For the Town of Highland Park, monthly water-use data collected since January 2016 through April 2019 is analyzed for year-over-year trends by each of the 12 months in the calendar year (e-Appendix B). The results of analyses begin here with the 2,338 Irrigation Only accounts.[11] This type of analysis results in 28,056 "account months" (2,388 x 12) that either feature an increasing or decreasing trend in water use or no trend across the three to four years studied depending on the month.[12] Appendix C features a spreadsheet of the results. Here, we summarize key findings.

Irrigation Only (IO) accounts have used the majority of water in the Town of Highland Park during the 40-month period of review: 58 percent (1771.4 of 3046.4 MG) (Appendix D). Water use by IO accounts fell below 50 percent of total monthly water use in the THP in just 12 of the 40 months in the dataset. The months of January and February in each of the four years studied account for eight of these 12 months. During the months of June through September of each of the three years for which there are data (i.e., 2016-2018), monthly IO water use ranges from 60-71 percent of total water use (except for June of 2016 when IO water use accounted for 52 percent of total water use).

When comparing monthly water use on a year-over-year basis, the majority of IO account months, over 70 percent, do not exhibit either an increasing or decreasing water-use trend during the period of analysis. For these accounts, the net change through time (i.e., across years) in water use for each of the 12 calendar months sums to a decrease of 7.37 million gallons (MG), 0.42 percent of the total water use by IO accounts over the 40-month period.[13]

Among those IO accounts that exhibit a usage trend, a greater number exhibit an increasing trend in monthly water use than those with a decreasing trend, year-over-year: 3,156 increasing account months versus 2,693 decreasing account months for a net change in monthly water use of +78.2 MG for increasing accounts and a net change in water use of -60.4 MG for account months that show a downward trend in water use. The net effect is a cumulative increase in use of 17.8 MG over the period analyzed. This translates to a one percent increase in water use over 40 months among IO accounts reporting some degree of monthly change.

[11] Monthly data are missing for a number of IO accounts.

[12] Here, a trend requires a minimum of three data points where an increase or decrease in water use is consistent from the first data point to the second point and on to the third data point at a minimum. For example, from Jan. 2016 to Jan 2019 there are four water-use data points. If there is an increase (or decrease) in water use each year after 2016, then there is an increasing (or decreasing) trend for the month of January, year-over year.

[13] 245,742 GPD X 30 = 7,372,260 gallons expressed on a monthly basis. Divide this product by 1,771,440,000 gallons of cumulative water use by IO accounts during the 40-month period of analysis and one arrives at 0.00416 or 0.42 percent.

Given that there are several factors that affect water use (e.g., temperature, precipitation, ET rate, water rates/rate structure, irrigation-controller sophistication, level of conservation program effort, ratepayer awareness, etc.) it is not possible to fully explain the water-use trends (or lack thereof) by Irrigation Only accounts given the single variable analyzed (i.e., monthly water use). Looking at year-over-year change per each of the 12 months in the year, narrows the degree of weather variability that will affect an entire year's worth of data in a simple year-to-year comparison. That said and as of April 2019, there is no apparent factor at work in the Town of Highland Park that is having the effect of reducing overall monthly water-use among IO accounts since January 1, 2016.

The Single-Family Residential (SFR) meter class uses the second greatest amount of water in the THP – 33.5 percent of total water use – and features 3,076 accounts (Appendix D). A subset of SFR accounts capture both indoor and outdoor water (i.e., they do not have an additional meter for irrigation-only use.) For what immediately follows, SFR accounts will capture a combination of those accounts that meter just indoor use (i.e., they have an additional outdoor-use meter) and those that meter both indoor and outdoor use with one meter.

Considering trends in monthly SFR water use over a 40-month period as done above for IO accounts, the majority of SFR account months – over 74 percent – do not exhibit an upward or downward trend in monthly use, year-over year (Appendix C). The number of account months with increasing monthly water use are nearly the same as those with decreasing water use. While the sum of monthly water use changes among all SFR accounts reporting change – those with increasing and decreasing trends and those with no apparent trend - indicates an overall net decrease of 11.9 MG, this amount of water-use change represents a small percentage of water use during 40 months among SFR accounts: 1.2 percent. Thus, we conclude that with this type of year-over-year monthly trend analysis, there is little at work other than perhaps passive conservation[14] to have affected a significant change or trend in water use among SFR accounts during the 40 months studied.

Together, IO and SFR meter-class accounts have used over 91 percent of the water sold by the Town of Highland Park during the 40-month period of analysis. The other three meter classes – commercial, multi-family residential, and municipal – collectively account for less than nine percent of total water use (Appendix D). Water conservation program efforts, therefore, should prioritize IO and SFR accounts with the former type offering the largest opportunity to reduce consumption of water and thus, achieve conservation goals once they are established.

Another dataset offered on the WaterSmart dashboard is a listing of accounts that are repeatedly in the highest tier of the water rate structure by using over 60,000 gallons per month for one to twelve months in the last year (e-Appendix E). A review of this dataset reveals that for the past 12 months, IO accounts constituted a large majority of water use in the THP as indicated above. Of the 589 accounts that are repeatedly in the highest tier, 492 are IO accounts. These IO accounts represent over 83 percent of the accounts that are in the highest water-use tier. Five of these IO accounts have consistently remained in the highest tier for 11 consecutive months. The average water use of these five accounts for those 11 months totals >120,000 gallons/month each. The average water use of the IO accounts repeatedly in the highest tier is 99,540 gallons/month each. The SFR accounts repeatedly in the highest tier use an average of 85,000 gallons/month each. This information can be used to target highest-use ratepayers for conservation outreach (e-Appendix E).

Four municipal accounts are also among the highest water-use tier: Town Hall & Fire Department (11 months), two accounts in the Davis Park swimming pool (6 and 4 months), and the Highland Park Town Services Center (1 month). While it was noted above that the municipal meter class is among a small minority of total water users relative to all five meter-class accounts, this information suggests that some of the municipal accounts use a disproportionately high amount of water, nonetheless.

[14] Passive conservation is the result of efficiency improvements (e.g., fixture upgrades) and typically not attributed to behavior change.

Another dataset in WaterSmart is "Consumption by Rate Tier" that, for each month from April 2017 to April 2019, gives the percentage of accounts (separated by meter class) that are in each of the 4 tiers (e-Appendix F). For the purpose of analyzing a complete year of 12 months, year 2018 is used for this analysis. On average in year 2018, 6.5 percent of IO accounts reach tier 4 of the THP water rate structure. The tier 4 IO accounts use an average 12.7 percent of total water used each month by all IO accounts. During the peak months of water use (May-September), the percent of IO accounts that reaches tier 4 nearly doubles to 12.8 percent, using an average of 21.6 percent of total water consumed by all IO accounts. Targeting these highest users for water-use conservation has the potential to offer the largest payback in terms of water-use reduction.

In 2018, nearly 14 percent of SFR accounts reached tier 2 which is 12,000 to 30,000 gallons per month. This group accounted for nearly 16 percent of total SFR consumption per month. During summer months (May-September), SFR accounts that reached tier 2 increased to almost 18 percent, making up 21.2 percent of total SFR consumption per summer month. The amount of increased water use among highest-tier users during the summer isn't as dramatic as with IO accounts, but this information can be used to target highest-use accounts with special conservation efforts.

Goal #4

The TSU team reached out to several staff members with the Highland Park Independent School District in pursuit of fulfilling the fourth project goal. Contact was made with Ms. Mary "Polly" McKeithen who was instrumental in organizing a conference call that included another HPISD colleague, Ms. Ashley Jones, and Ms. Julie Seymour and Mr. Keith Nix, both of whom represent the Dallas-based EarthX organization.

It was established that currently, there is no water-conservation curriculum at either the HPISD or embedded within EarthX activities. EarthX does feature some type of water-related display or activity at their annual expo and the two representatives expressed interest in developing some type of conservation-related activity or message for the 2020 expo in collaboration with those of us on the call and the THP.

Ms. Jones is involved with the HPISD's STEAM program for K-12 students. The STEAM program is STEM (science, technology, engineering, and math) oriented plus Arts. Ms. Jones offered to look into introducing more water use/conservation related material into the STEAM program and suggested that water as a general topic could perhaps substitute (on occasion or a rotating basis) for one of the four topical areas.

It is clear from the conversation had with the HPISD (through their STEAM program) and EarthX representatives (through their annual expo) that there is interest in promoting the topic of water-use conservation and collaboration with the THP to do so. It is up to the THP or their representative/consultant, therefore, to become substantively involved in developing the nascent collaboration that this initial telephone conversation has started.

As for the strategic plan between the THP and the HPISD that has been mentioned in the last two five-year water conservation plans, the TSU team was unable to uncover a copy or talk with anyone who was familiar with it or its content.[15] Perhaps related to this plan, or not, Ms. McKeithen mentioned that as far as HPISD facilities are concerned, rain sensors have been installed at all school properties and some degree of dripline irrigation is in use.

The TSU team is appreciative of these individuals and Ms. McKeithen in particular. Lastly, Polly McKeithen offered to introduce the TSU team to the City Manager and Parks Dept. staff at University Park, the THP's neighbor. This offer can be accepted if the THP wishes to pursue collaboration with University Park on water-use conservation and wishes for the TSU team to remain involved.

[15] The TSU team did not make contact with the THP consultant that developed their 5-year water conservation plan where reference to a strategic plan with the HPISD is made.

RECOMMENDATIONS

In order to benefit fully from the promise of a water conservation program, the Town of Highland Park should hire a new conservation coordinator whose focus will be to develop and manage a new water conservation program. Without a manager whose sole focus is development and management of a water conservation program, one that employs available tools, takes full advantage of data generated by the THP's new meters and WaterSmart software, and fully supported and resourced by the Town Council and executive staff, measurable progress with conserving water will be elusive. Conservation-planning tool output offers an excellent guide for choosing measures for implementation. A new conservation coordinator can be a part-time, full-time, or full-time-shared (e.g., with University Park?) staff member.

The THP should phase out use of potable water on their town-owned properties by making a commitment to showcasing native and regionally-appropriate (i.e., drought tolerant) plants and using either rainwater or reclaimed water when watering is necessary. The THP must lead by example for ratepayers and school-aged children alike and use their town-managed landscapes as demonstration projects and key components of a conservation awareness and outreach campaign. Attractive (flowering) plants and landscapes that meet the abovementioned criteria are available and in use in many places. Ample resources are available to the THP within the Dallas-Ft. Worth region (and Texas State University) to help achieve such a new goal.

Current Highland Park water rates and the tiered-rate structure should be reimagined to both pay for and incentivize water-use conservation. Conservation planning tool results indicate how a conservation program can be paid for by adjustments to scheduled rate increases. Adding outdoor-watering measures and a new conservation coordinator will lead to additional costs that can be fully or partially offset by higher water rates and a new tier-based rate structure. The THP's first tier is too wide and should be narrowed such that use of 12,000 gallons per month invokes a third or fourth water-rate tier. Any future cost-of-service study should include covering the costs of a new conservation coordinator and a robust conservation program of both indoor- and outdoor-focused measures.

The THP must actively engage with the Highland Park Independent School District and other willing collaborators in order to ensure that K-12 school-aged residents adopt a water conservation ethic to carry forward in life. Collaboration with like-minded entities will take some effort and require a commitment on the part of the THP. A new conservation coordinator can be the staff person for leading this effort and achieving this goal. But it will take all staff and elected officials to ensure that THP policies and practices lead by example. Lack of action on the part of the THP will dilute the momentum that this project has created.

The THP should invest in data development about average lot size, landscaped area per lot, and turf grass per lot. These new data will inform a conservation program of outdoor watering measures and help with development of outdoor water budgets if the THP wants to pursue such a way to price water. In any event, these new data are necessary to examine potential benefit-cost ratios and the net present value of investing in measures to reduce outdoor-water use.

Reducing outdoor watering should be emphasized in a new water-conservation program. Outdoor water use is the single largest user of water in the THP. Any real progress with reducing overall water use in the THP must come from reductions in outdoor watering and primarily from IO meter-class accounts. Beyond steps such as making time-of-day watering hours a year-round feature of the town ordinance, narrowing the time-of-day outdoor-watering window(s), and needed adjustments to water rates and the THP rate structure, more creative efforts will be necessary and could include incentives to convert part of residential landscapes to native and regionally-adapted plantscapes. The THP should consider participating in the WaterMyYard program and incentivizing alternatives to timer-based controllers or even those that claim to be rain-sensitive. The new conservation coordinator can take full advantage of the THP's investment in smart meters and advanced software to target messaging, high-users, and experiment with other tactics to effect measurable change.

FINAL THOUGHTS

Implementing a conservation program has been justified from a financial perspective and that was achieved with a focus solely on indoor water-use measures. Developing a scenario of outdoor water-use measures should prove to make economic sense for Highland Park too. Additionally, a watershed-based appeal for stewardship of a shared resource has been made to help enlist community buy-in. Going forward, the leaders and residents of Highland Park must also build a shared vision for their community's water future; one that is inextricably tied to a growing number of fellow Texans.

Opportunities and potential for achieving measurable progress with water conservation are numerous and with key investments made in advanced meter technology and data management software, Highland Park is positioned well to become a model community of water-use conservation and management. Now is the time to summon the political will and other resources, prepare for the next inevitable drought, and add a new dimension to being "an American community making a difference."

ACKNOWLEDGMENTS

The Texas State University team wishes to express our sincere appreciation for the invitation to perform this work, including funding and other support, to the Town of Highland Park executive staff: Mr. Bill Lindley, Town Administrator; Mr. Steven Alexander, Director of Administrative Services & Chief Financial Officer; and Ms. Kathleen Stewart, Director of Town Services. We wish to also thank former mayor, Joel T. Williams, III, Dr. Andy Sansom, Texas State University, and Mr. Mike McCoy, The Meadows Foundation, for organizing the dinner meeting to exchange ideas on April 26, 2017 that included both Mr. Lindley and Mr. Alexander. We are grateful for the support of other Town staff that we met or talked with and numerous others in Texas and elsewhere that helped us achieve the four project goals. We also acknowledge and thank The Meadows Foundation and the Meadows Center for Water and the Environment, Texas State University, for the Endowed Chair in Water Conservation, presently held by Dr. Tim Loftus, that also provided funding support for this project. The TSU team takes full responsibility for the information presented here along with the views expressed, recommendations made, and any errors or omissions.

APPENDIX A: PEER CITIES, CONTACT INFORMATION

City	Name	Title	Contact Info
Alamo Heights, TX	Pat Sullivan	Director of Public Works	(210) 882-1506; psullivan@alamoheightstx.gov
Irving, TX	Donna Starling	Water Programs Manager	(972) 721-2431; dstarling@cityofirving.org
Southlake, TX	Ashley Carlisle	Environmental Coordinator	(817) 748-8638; acarlisle@ci.southlake.tx.us
West University Place, TX	Susan White	Parks and Rec Director	(713) 662-5894; SWhite@westutx.gov
	Patrick Walters	Operations Superintendent	(713) 662-5858; pwalters@westutx.gov
Westlake, TX	Jarrod Greenwood	Director of Public Works	(817) 490-5717; jgreenwood@westlake-tx.org
	Dianna Orender	Public Works Assistant	(817) 490-5732; customerservice@westlake-tx.org
Westover Hills, TX	Tim Chambers	Public Works Director	(817) 737-8442; t.chambers@westoverhills.us
The Woodlands, TX	Bob Dailey	Water Awareness and Public Education Coordinator for the WJPA	(281) 367-1271; bdailey@wjpa.org
	Jason Williams	Operations and Maintenance Manager	(281) 367-9511; jwilliams@sjra.net
	Chris Nunes	Director of Parks and Recreation	(281) 210-3800; cell (936) 672-3907
Cary, NC	Scott Hecht	Public Works Department Director	(919) 469-4093; scott.hecht@townofcary.org
	Jeff Adkins	Water Resources Manager	(919) 462-2066; jeff.adkins@townofcary.org
Santa Fe, NM	Patricio Pacheco	Water Conservation Education & Compliance Specialist	(505) 955-4221; pmpacheco@santafenm.gov
Scottsdale, AZ	No correspondence		

e-APPENDIX B: READING DETAIL BY ACCOUNT

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This appendix is available to Town of Highland Park executive staff only.

APPENDIX C: ACCOUNT MONTHS

THP Water Use Trends																
	Irrigation-only Trend*	***Total Irrigation-Only Accounts = 2,338**														
		Water	**% of**	**GPD change**	**Water**	**% of**	**GPD Change**	Bounce in	**% of**	**GPD Change**	**No change**	**% of**	**No-data**	**% of**	**Total**	**TOTALS**
	January-1	33	1.85%	29,247	67	3.76%	-44,010	1569	87.95%	70,126	115	6.45%	554	31.05%	1,784.00	2,338.00
Jan-Mar: 2016-2019 data(4 data	February-2	31	1.73%	21,670	93	5.19%	-67,568	1564	87.33%	-139,496	103	5.75%	547	30.54%	1,791.00	2,338.00
	March-3	16	0.89%	11,631	171	9.48%	-126,854	1521	84.36%	-290,795	95	5.27%	535	29.67%	1,803.00	2,338.00
	April-4	206	11.41%	106,734	321	17.77%	-208,706	1201	66.50%	-85,009	78	4.32%	532	29.46%	1,806.00	2,338.00
	May-5	551	30.32%	346,486	104	5.72%	-59,294	1111	61.14%	147,258	51	2.81%	521	28.67%	1,817.00	2,338.00
	June-6	894	48.69%	828,630	51	2.78%	-30,381	848	46.19%	258,363	43	2.34%	502	27.34%	1,836.00	2,338.00
Apr-Dec: 2016-2018 data(3 data	July-7	470	25.27%	532,572	73	3.92%	-48,196	1275	68.55%	387,648	42	2.26%	478	25.70%	1,860.00	2,338.00
	August-8	205	10.92%	197,989	183	9.74%	-141,959	1454	77.42%	70,890	36	1.92%	460	24.49%	1,878.00	2,338.00
	September-9	394	20.85%	330,376	186	9.84%	-156,773	1267	67.04%	106,219	43	2.28%	448	23.70%	1,890.00	2,338.00
	October-10	146	7.68%	88,795	482	25.36%	-404,484	1234	64.91%	-224,177	39	2.05%	437	22.99%	1,901.00	2,338.00
	November-11	66	3.45%	34,348	657	34.38%	-533,182	1138	59.55%	-407,874	50	2.62%	427	22.34%	1,911.00	2,338.00
	December-12	144	7.50%	78,426	305	15.88%	-192,264	1393	72.51%	-138,895	79	4.11%	417	21.71%	1,921.00	2,338.00
	Average		14.21%			11.99%			70.29%			3.51%				100.00%
	Sum (of accounts)	3156			2,693			15,575			774		5,858		22,198.00	28,056
Percent accounts of total (accounts over 40 months period)		11.25%			9.60%			55.51%			2.76%		20.88%		79.12%	100.00%
	Sum (of GPD)			**2,606,904**			**-2,013,671**			**-245,742**						**347,491**
	Total Change (gallons)			**78,207,120**			**-60,410,130**			**-7,372,260**						**10,424,730**
	SFR Trend**	***Total SFR Accounts = 3,076**														
		Water INCREASE accounts	**% of accounts**	**GPD change (of "increases")**	**Water DECREASE accounts**	**% of accounts**	**GPD Change (of "decreases")**	**Bounce in trend/ AKA no trend accounts**	**% of accounts**	**GPD Change (of "no trends")**	**No change accounts (same every year)**	**% of accounts**	**No-data accounts (-)**	**% of accounts**	**Total accounts (with data)**	**TOTALS**
	January-1	46	2.00%	17,249	73	3.17%	-35,148	2126	92.27%	-50,652	59	2.56%	772	33.51%	2304	3076
Jan-Mar: 2016-2019 data(4 data	February-2	35	1.51%	13,868	84	3.63%	-41,155	2133	92.14%	-47,456	63	2.72%	761	32.87%	2315	3076
	March-3	59	2.54%	26,840	93	4.00%	-38,185	2158	92.86%	-88,259	14	0.60%	752	32.36%	2324	3076
	April-4	215	9.20%	51,793	281	12.03%	-74,059	1680	71.92%	-24,081	160	6.85%	740	31.68%	2336	3076
	May-5	456	19.41%	120,103	117	4.98%	-37,000	1646	70.07%	44,227	130	5.53%	727	30.95%	2349	3076
	June-6	484	20.40%	166,950	154	6.49%	-43,157	1615	68.09%	58,903	119	5.02%	704	29.68%	2372	3076
	July-7	371	15.46%	131,903	212	8.83%	-58,171	1698	70.75%	43,309	119	4.96%	676	28.17%	2400	3076
Apr-Dec: 2016-2018 data(3 data	August-8	206	8.51%	74,348	331	13.67%	-111,974	1764	72.86%	-35,490	120	4.96%	655	27.05%	2421	3076
	September-9	299	12.22%	87,670	253	10.34%	-79,768	1736	70.94%	-12,939	159	6.50%	629	25.70%	2447	3076
	October-10	202	8.21%	51,894	371	15.08%	-143,722	1708	69.40%	-63,867	180	7.31%	615	24.99%	2461	3076
	November-11	156	6.31%	34,436	470	19.01%	-166,588	1704	68.90%	-100,833	143	5.78%	603	24.38%	2473	3076
	December-12	229	9.20%	52,031	300	12.05%	-97,608	1773	71.23%	-23,311	187	7.51%	587	23.58%	2489	3076
	Average		9.58%			9.44%			75.95%			5.03%		28.74%		100.00%
	Sum (of accounts)	2758			2,739			21,741			1,453		8,221		28,691	36,912
Percent accounts of total (accounts over 40 months period)		7.47%			7.42%			59%			3.94%		22%		77.73%	100.00%
	Sum (of GPD)			**829,085**			**-926,535**			**-300,449**						**-397,899**
	Total Change (gallons)			**24,872,550**			**-27,796,050**			**-9,013,470**						**-11,936,970**

APPENDIX D: MONTHLY WATER USE BY METER CLASS

Monthly Water Use by Sector: January 2016 - April 2019 (MG)											
Period	*SFR Accts*	*% SFR Accts*	*Irrigation Accts*	*% Irrigation*	*Commercial*	*% Commercial*	*MFR Accts*	*% MFR Accts*	*Municipal*	*% Municipal*	*All Accounts*
Jan-16	23.2	52.0	16.5	37.0%	2.5	5.6%	2.3	5.2%	0.1	0.2%	44.6
Feb-16	24.7	44.7	25.3	45.8%	2.7	4.9%	2.4	4.3%	0.1	0.2%	55.2
Mar-16	22.1	40.2	28.2	51.3%	2.5	4.5%	2.1	3.8%	0.1	0.2%	55
Apr-16	25.8	36.0	40.4	56.4%	3	4.2%	2.3	3.2%	0.2	0.3%	71.6
May-16	21.5	37.3	30.2	52.3%	3.5	6.1%	2.2	3.8%	0.2	0.3%	57.7
Jun-16	26.2	37.8	36.1	52.1%	4.2	6.1%	2.6	3.8%	0.3	0.4%	69.3
Jul-16	27.5	28.9	60.7	63.7%	4.1	4.3%	2.6	2.7%	0.5	0.5%	95.3
Aug-16	36.7	26.0	96.4	68.2%	4.7	3.3%	3.1	2.2%	0.5	0.4%	141.4
Sep-16	29.2	27.4	69.4	65.2%	4.1	3.9%	3.1	2.9%	0.6	0.6%	106.4
Oct-16	28.6	29.6	61.5	63.7%	3.3	3.4%	2.8	2.9%	0.3	0.3%	96.5
Nov-16	29.1	33.1	51.7	58.8%	4.1	4.7%	2.7	3.1%	0.3	0.3%	87.9
Dec-16	23.7	40.0	29.9	50.5%	3.1	5.2%	2.2	3.7%	0.2	0.3%	59.2
Jan-17	24.9	46.7	22.9	43.0%	3	5.6%	2.3	4.3%	0.2	0.4%	53.3
Feb-17	25.1	42.9	27.6	47.2%	3.3	5.6%	2.4	4.1%	0.1	0.2%	58.5
Mar-17	21.7	38.8	28.8	51.5%	3.1	5.5%	2.1	3.8%	0.1	0.2%	55.9
Apr-17	23.6	34.9	38.07	56.3%	3.4	5.0%	2.3	3.4%	0.3	0.4%	67.6
May-17	26.1	34.5	43.13	57.1%	3.7	4.9%	2.4	3.2%	0.3	0.4%	75.6
Jun-17	27.6	31.9	51.75	59.9%	3.7	4.3%	2.6	3.0%	0.7	0.8%	86.4
Jul-17	26.2	28.9	57.36	63.2%	3.7	4.1%	2.7	3.0%	0.7	0.8%	90.7
Aug-17	28.8	27.1	70.22	66.2%	3.6	3.4%	2.8	2.6%	0.7	0.7%	106.1
Sep-17	30.2	27.1	73.13	65.7%	4.7	4.2%	2.8	2.5%	0.5	0.4%	111.3
Oct-17	27.9	28.2	63.77	64.5%	4.3	4.3%	2.6	2.6%	0.4	0.4%	98.9
Nov-17	27.4	31.1	54.44	61.7%	3.5	4.0%	2.7	3.1%	0.2	0.2%	88.2
Dec-17	25.1	34.6	41.67	57.5%	2.9	4.0%	2.6	3.6%	0.2	0.3%	72.5
Jan-18	24.3	48.7	19.84	39.8%	3.1	6.2%	2.4	4.8%	0.1	0.2%	49.9
Feb-18	23.5	45.5	21.89	42.4%	3.4	6.6%	2.6	5.0%	0.1	0.2%	51.6
Mar-18	18.6	45.1	17.38	42.2%	2.9	7.0%	2.2	5.3%	0.1	0.2%	41.2
Apr-18	23.7	37.4	33.59	53.1%	3.1	4.9%	2.6	4.1%	0.2	0.3%	63.3
May-18	25.8	33.2	45.51	58.6%	3.5	4.5%	2.5	3.2%	0.3	0.4%	77.6
Jun-18	32.3	27.9	74.99	64.8%	4.4	3.8%	3.4	2.9%	0.5	0.4%	115.7
Jul-18	31.7	24.2	91.79	70.2%	3.8	2.9%	2.8	2.1%	0.7	0.5%	130.8
Aug-18	33.6	23.3	102.5	71.2%	4.3	3.0%	2.9	2.0%	0.7	0.5%	144
Sep-18	29.2	24.9	80.98	69.1%	3.7	3.2%	2.7	2.3%	0.5	0.4%	117.2
Oct-18	23.2	32.0	43.35	59.8%	3.1	4.3%	2.4	3.3%	0.4	0.6%	72.5
Nov-18	20.6	44.4	19.78	42.6%	3.4	7.3%	2.4	5.2%	0.2	0.4%	46.4
Dec-18	20.9	43.5	21.25	44.3%	3.6	7.5%	2.1	4.4%	0.1	0.2%	48
Jan-19	20.0	47.7	16.05	38.3%	3.7	8.8%	2.1	5.0%	0.1	0.2%	41.9
Feb-19	21.4	46.0	18.47	39.7%	4.1	8.8%	2.4	5.2%	0.2	0.4%	46.5
Mar-19	17.5	47.6	14.01	38.1%	3.2	8.7%	2	5.4%	0.1	0.3%	36.8
Apr-19	21.2	36.6	30.92	53.4%	3.3	5.7%	2.3	4.0%	0.3	0.5%	57.9
Total	1020.4	33.50	1771.44	58.15%	141.3	4.64%	100.5	3.30%	12.4	0.41%	3046.4

e-APPENDIX E: ACCOUNTS REPEATEDLY IN HIGHEST WATER USE TIER

View online at http://bit.ly/HighlandParkReport-e-AppendixE.

This appendix is available to Town of Highland Park executive staff only.

e-APPENDIX F: WATER CONSUMPTION BY RATE TIER

View online at http://bit.ly/HighlandParkReport-e-AppendixF.

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