Rainwater harvesting system installations required to offset new water demand created by growing populations in Broward and Palm Beach Counties: A dataset for decision making based on numbers of installations, costs, and water and energy savings

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This article presents yearly data for the period 2020–2060 on estimates for population growth and associated numbers of new and existing single-family detached homes to be fit or retrofit with rainwater harvesting (RWH) system equipment for lawn irrigation in order to continuously offset new water demand created by new residents in Broward and Palm Beach Counties, Florida. Annual data on financing costs for capital equipment and its replacement and savings in amounts of groundwater and associated water supply energy amounts and costs are also provided. The methods for determining and using the data presented in this article, along with related data, for the purpose of analyzing the feasibility of a widely-deployed residential rainwater harvesting (RWH) system in a heavily populated region in Southeast Florida are discussed in detail in Wurthmann [1]. The data presented here can be used by policy makers as a decision support tool for assessing broad outcomes related to population and single-family housing growth in Broward and Palm Beach Counties. They can also be used for more circumscribed outcomes related to developing implementation plans and assessing capital and financing costs and savings in water and energy amounts and costs for countywide RWH system.
installations. The data were derived from various expert projections, data from the U.S. Census Bureau, National Association of Home Builders (NAHB), Florida Department of Revenue and Property Tax, American Water Resources Association (AWRA), South Florida Water Management District (SFWMD), Electric Power Research Institute (EPRI), Energy Information Administration (EIA), and vendors of RWH system equipment, and customized calculations developed in Wurthmann [1].

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Specifications Table

| Subject | Water Science and Technology |
|---------|-------------------------------|
| Specific subject area | Water, energy, and cost savings through regionally deployed residential rainwater harvesting systems for lawn irrigation |
| Type of data | Tables |
| How data were acquired | All data used in the analysis and presented here were derived from secondary datasets using calculations described herein. No software/programs or hardware were used. |
| Data format | All raw and analysed data is provided in the present data article. |
| Parameters for data collection | It is assumed that rates of water usage, sizes of homes and lots, numbers of people residing in homes, breakdowns of the percentages of homes based on numbers of bedrooms, and yearly ratios of numbers of single-family detached homes to numbers of people residing in Broward and Palm Beach Counties, Florida, as well as energy intensity of water and costs will remain constant through 2060. |
| Description of data collection | Data were collected from various secondary sources for further analysis and integration, as described in Wurthmann [1], to create the data tables contained in this paper. |
| Data source location | Data were collected for further analysis and integration, as described in Wurthmann [1], to create the data tables contained in this paper from the following secondary sources: high and low expert projections for populations at the turn of each decade from 2010 to 2060 [2,3]; population growth, averages of numbers of people residing in homes, and breakdowns of the percentages of homes based on numbers of bedrooms in Broward and Palm Beach Counties, Florida, for the years 2010 through 2017 [4]; rates of divergence between high and low population projections, based on length of time for the projections [5]; data on existing permits for pumping water from the Biscayne Aquifer and actual 2010 water supply pumpage quantities and corresponding figures for the populations using that water in Broward and Palm Beach Counties, Florida [2,6,7]; data on the average square footages of homes corresponding to numbers of bedrooms in the homes [8]; data on average lot sizes in Broward and Palm Beach Counties, Florida, in 2017 [9]; data on the required application rate of water to landscaped areas in Florida [10,11]; data on historical daily rainfall amounts from 2007 to 2017 in Fort Lauderdale, Florida [12]; vendor-based estimates of costs for RWH system equipment and its installation [13]; data on energy intensity of groundwater [14]; data on costs of energy for Florida industrial customers [15]. |
| Data accessibility | All raw and analysed data are included with this article. Please see data in article and Tables 1–3. |
| Related research article | Kurt Wurthmann Assessing storage requirements, water and energy savings, and costs associated with a residential rainwater harvesting system deployed across two counties in Southeast Florida Journal of Environmental Management Volume 252, 15 December 2019, 109673 [1] |
Value of the Data

- These data are useful because they are the first to provide annual projections for Broward and Palm Beach Counties, Florida, during the period 2020–2060, for population growth, numbers of detached homes that must be fit with RWH system equipment each year so 100% of water demand by new residents is continuously offset, and costs and savings in groundwater and energy for its supply.
- These data are useful because they summarize a unique integration of data using new analytic approaches, including techniques for RWH system sizing based on a nonparametric bootstrapping approach that synthetically generates daily precipitation, water supply, and irrigation demand using historical daily rainfall data.
- These data can benefit researchers, analysts, and policy makers who have interests in outcomes related to population and single-family housing growth in Broward and Palm Beach Counties and developing implementation plans and assessing costs and savings in water and energy for countywide RWH system installations.
- The methods used to derive these data can be modified for use in future studies of sustainable water management, which consider alternative contextual conditions, including changes in focal locations, population projections, percentages of populations residing in detached houses, per capita daily water usage, use of harvested rainwater, costs and energy usage, and climate.

1. Data

All raw and analysed data are included with this article. Please see data in the article and Tables 1–3. Note, there can be increasing levels of uncertainty associated with population projections as the dates for the projections extend longer into the future [5]. To account for this uncertainty it is common practice to provide high and low series of population projections, rather than provide just one series of medium projections [2,3,5]. Accordingly, the present and related research articles [1,2,5] developed high and low projections for population growth in Broward and Palm Beach Counties.

Table 1 presents annual data on high projections for population growth and associated numbers of new and existing single-family detached homes to be fit or retro fit with RWH system equipment for lawn irrigation in order to continuously offset 100% of water demand created by new residents in such homes in Broward and Palm Beach Counties, in Florida. Column 1 shows the years of data, which extend from 2020 to 2060. Columns 2–5 show the high population projections for numbers of people and single-family detached homes in Broward and Palm Beach Counties, respectively. Columns 6 and 7 show the numbers of new single-family detached homes that are created and must be fit with RWH equipment each year due to the growing populations in Broward and Palm Beach Counties, respectively. Column 8 shows the numbers of existing single-family detached homes that must be retro fit with RWH equipment each year in Broward County, in order to offset 100% of the water demand created that year by newly built Broward and Palm Beach County single-family detached homes. The process of retrofitting Broward County homes with RWH system equipment continues until all existing Broward single-family detached homes are so retrofit. At that point, the process of fitting new and retrofitting existing Palm Beach County single-family detached homes with RWH system equipment begins. This sequence is chosen because it is more expensive to fit Palm Beach versus Broward County homes with RWH system equipment. Column 9 shows the numbers of existing single-family detached homes that must be retrofit with RWH equipment each year in Palm Beach County, in order to offset 100% of the water demand created that year by newly built Broward and Palm Beach County single-family detached homes. The process of retrofitting existing Palm Beach County single-family detached homes with RWH system equipment continues through 2060. Columns 10 and 11 show the total numbers of new and existing single-family detached homes that must be fit or retrofit with RWH equipment each year in Broward (sum of columns 6 and 8) and Palm Beach (sum of columns 7 and 9) Counties, respectively.

Table 2 presents annual data on expenses for RWH system capital equipment and its installation and replacement, the costs for financing of these expenses, and savings in amounts of groundwater and associated water supply energy amounts and costs in Broward and Palm Beach Counties, in Florida. Column 1 shows the years of data, which extend from 2020 to 2060. Column 2 shows the total expenses required in each year for RWH system capital equipment and its installation and replacement. Column 3 shows the total dollar amount spent each year for financing the expenses over a 20-year period, at an interest rate of six percent, structured with level debt service. Column 4 shows the present values of the
Table 1
High projections for population growth and associated numbers of new and existing single-family homes to be fit or retrofit with RWH system equipment for lawn irrigation to continuously offset 100% of water demand created by new residents in such homes in Broward and Palm Beach Counties, in Florida.

| Year | [A] High projections for Broward population | [B] High projections for Palm Beach population | [0.181\*A] Broward County Number detached homes | [0.221\*B] Palm Beach County Number detached homes | Number of new detached homes created and to be fit with RWH equipment each year by the growing population in Broward | Number of new detached homes created and to be fit with RWH equipment each year by the growing population in Palm Beach | Number of existing homes to be retrofit with RWH equipment each year to offset 100% of water demand created by new Broward & Palm Beach homes until all existing Broward homes retrofit | Number of existing homes to be retrofit with RWH equipment each year to offset 100% of water demand created by new Broward & Palm Beach homes | Number of new and existing detached homes that must be fit or retrofit with RWH equipment each year in Broward | Number of new and existing detached homes that must be fit or retrofit with RWH equipment each year in Palm Beach |
|------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|
| 2020 | 1946700                                   | 1482900                                     | 352353                                      | 327721                                      | 0                                           | 0                                           | 0                                           | 0                                           | 0                                           | 0                                           |
| 2021 | 1965709                                   | 1498637                                     | 355864                                      | 331199                                      | 3511                                        | 3478                                        | 16161                                       | 0                                           | 19671                                       | 0                                           |
| 2022 | 1985687                                   | 1514541                                     | 359409                                      | 334713                                      | 3546                                        | 3515                                        | 16329                                       | 0                                           | 19874                                       | 0                                           |
| 2023 | 2005472                                   | 1530613                                     | 362990                                      | 338266                                      | 3581                                        | 3552                                        | 16498                                       | 0                                           | 20079                                       | 0                                           |
| 2024 | 2025454                                   | 1546856                                     | 366607                                      | 341855                                      | 3617                                        | 3590                                        | 16670                                       | 0                                           | 20287                                       | 0                                           |
| 2025 | 2045636                                   | 1562272                                     | 370260                                      | 345483                                      | 3653                                        | 3628                                        | 16843                                       | 0                                           | 20496                                       | 0                                           |
| 2026 | 2066018                                   | 1579862                                     | 373949                                      | 349149                                      | 3689                                        | 3666                                        | 17018                                       | 0                                           | 20707                                       | 0                                           |
| 2027 | 2086604                                   | 1596627                                     | 377675                                      | 352855                                      | 3726                                        | 3705                                        | 17195                                       | 0                                           | 20921                                       | 0                                           |
| 2028 | 2107395                                   | 1613571                                     | 381438                                      | 356599                                      | 3763                                        | 3745                                        | 17374                                       | 0                                           | 21137                                       | 0                                           |
| 2029 | 2128393                                   | 1630695                                     | 385239                                      | 360384                                      | 3801                                        | 3784                                        | 17554                                       | 0                                           | 21355                                       | 0                                           |
| 2030 | 2149600                                   | 1648000                                     | 389078                                      | 364208                                      | 3838                                        | 3824                                        | 17737                                       | 0                                           | 21575                                       | 0                                           |
| 2031 | 2168818                                   | 1661306                                     | 392556                                      | 367149                                      | 3478                                        | 2941                                        | 14455                                       | 0                                           | 17933                                       | 0                                           |
| 2032 | 2188208                                   | 1674719                                     | 396066                                      | 370113                                      | 3510                                        | 2964                                        | 14576                                       | 0                                           | 18086                                       | 0                                           |
| 2033 | 2207771                                   | 1688241                                     | 399607                                      | 373101                                      | 3541                                        | 2988                                        | 14699                                       | 0                                           | 18240                                       | 0                                           |
| 2034 | 2227509                                   | 1701872                                     | 403179                                      | 376114                                      | 3573                                        | 3012                                        | 14822                                       | 0                                           | 18395                                       | 0                                           |
| 2035 | 2247424                                   | 1715613                                     | 406784                                      | 379150                                      | 3605                                        | 3037                                        | 14947                                       | 0                                           | 18551                                       | 0                                           |
| 2036 | 2267517                                   | 1729465                                     | 410421                                      | 382212                                      | 3637                                        | 3061                                        | 15072                                       | 0                                           | 18709                                       | 0                                           |
| 2037 | 2287789                                   | 1743429                                     | 414090                                      | 385298                                      | 3669                                        | 3086                                        | 15199                                       | 0                                           | 18868                                       | 0                                           |
| 2038 | 2308243                                   | 1757505                                     | 417792                                      | 388409                                      | 3702                                        | 3111                                        | 15326                                       | 0                                           | 19028                                       | 0                                           |
| 2039 | 2328879                                   | 1771695                                     | 421527                                      | 391545                                      | 3735                                        | 3136                                        | 15455                                       | 0                                           | 19190                                       | 0                                           |
| 2040 | 2349700                                   | 1786000                                     | 425296                                      | 394706                                      | 3769                                        | 3161                                        | 15585                                       | 0                                           | 19354                                       | 0                                           |
| 2041 | 2370307                                   | 1808920                                     | 428977                                      | 399771                                      | 3681                                        | 5065                                        | 21316                                       | 0                                           | 24997                                       | 0                                           |
| 2042 | 2390549                                   | 1832134                                     | 432689                                      | 404902                                      | 3713                                        | 5130                                        | 11523                                       | 1008                                        | 15236                                       | 6138                                        |
| 2043 | 2411240                                   | 1855645                                     | 436434                                      | 410098                                      | 3745                                        | 5196                                        | 0                                           | 8139                                        | 3745                                        | 13335                                       |
| 2044 | 2432109                                   | 1879459                                     | 440212                                      | 415360                                      | 3777                                        | 5263                                        | 0                                           | 8229                                        | 3777                                        | 13492                                       |
| 2045 | 2453159                                   | 1903578                                     | 444022                                      | 420691                                      | 3810                                        | 5330                                        | 0                                           | 8320                                        | 3810                                        | 13650                                       |
| 2046 | 2474391                                   | 1928006                                     | 447865                                      | 426089                                      | 3843                                        | 5399                                        | 0                                           | 8411                                        | 3843                                        | 13810                                       |
| 2047 | 2495807                                   | 1952748                                     | 451741                                      | 431557                                      | 3876                                        | 5468                                        | 0                                           | 8504                                        | 3876                                        | 13972                                       |
| Year | Valuation 1 | Valuation 2 | Valuation 3 | Valuation 4 | Valuation 5 | Valuation 6 | Valuation 7 | Valuation 8 | Valuation 9 |
|------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 2048 | 2517408     | 1977808     | 455651      | 437096      | 3910        | 5538        | 0           | 8598        | 3910        | 14136       |
| 2049 | 2539196     | 2003189     | 459595      | 442705      | 3944        | 5609        | 0           | 8693        | 3944        | 14302       |
| 2050 | 2561173     | 2028896     | 463572      | 448386      | 3978        | 5681        | 0           | 8789        | 3978        | 14470       |
| 2051 | 2577076     | 2058047     | 466451      | 454828      | 2878        | 6442        | 0           | 8419        | 2878        | 14862       |
| 2052 | 2593078     | 2087618     | 469347      | 461364      | 2896        | 6535        | 0           | 8518        | 2896        | 15053       |
| 2053 | 2609179     | 2117613     | 472261      | 467992      | 2914        | 6629        | 0           | 8618        | 2914        | 15247       |
| 2054 | 2625381     | 2148039     | 475194      | 474717      | 2932        | 6724        | 0           | 8719        | 2932        | 15443       |
| 2055 | 2641683     | 2178903     | 478145      | 481537      | 2951        | 6821        | 0           | 8822        | 2951        | 15643       |
| 2056 | 2658086     | 2210209     | 481114      | 488456      | 2969        | 6919        | 0           | 8926        | 2969        | 15845       |
| 2057 | 2674591     | 2241966     | 484101      | 495475      | 2987        | 7018        | 0           | 9031        | 2987        | 16049       |
| 2058 | 2691198     | 2274179     | 487107      | 502594      | 3006        | 7119        | 0           | 9138        | 3006        | 16257       |
| 2059 | 2707909     | 2306855     | 490131      | 509815      | 3025        | 7221        | 0           | 9246        | 3025        | 16467       |
| 2060 | 2724723     | 2340000     | 493175      | 517140      | 3043        | 7325        | 0           | 9355        | 3043        | 16680       |
Table 2
Expenses for RWH system capital equipment and its installation and replacement, the costs for financing these expenses, and savings in amounts of groundwater and associated water supply energy amounts and costs in Broward and Palm Beach Counties, in Florida.

| Year | Total annual capital expenses for new installations and replacements of RWH equipment ($) | Total yearly payments for financing total yearly capital expenses ($) | Present values of total yearly payments for financing total yearly capital expenses ($) | Total amount of groundwater saved, each year, across both counties, by the RWH system (MGY) | Total amount of groundwater saved, each year, across both counties, by the RWH system (Mm³Y) | Total annual water supply energy savings (kwh) | Total annual water supply energy cost savings ($) | Present values of total annual energy cost savings ($) |
|------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 2020 | 0                                                                                       | 0                                                                  | 0                                                                                    | 0                                                                                           | 0                                                                                           | 0                                                                                           | 0                                                                                           | 0                                                                                                      |
| 2021 | 98356783                                                                               | 857193                                                             | 8089804                                                                             | 1023                                                                                        | 3.87                                                                                        | 2147573                                                                                      | 162786                                                                                        | 153572                                                                                               |
| 2022 | 99371541                                                                               | 15342521                                                           | 8089804                                                                             | 1173                                                                                        | 7.78                                                                                        | 4317303                                                                                      | 327252                                                                                        | 291253                                                                                               |
| 2023 | 99371541                                                                               | 15342521                                                           | 8089804                                                                             | 13227401                                                                                   | 7.78                                                                                        | 1061773                                                                                      | 830089                                                                                        | 620896                                                                                               |
| 2024 | 100396778                                                                              | 25792790                                                          | 8089804                                                                             | 14774101                                                                                   | 15.73                                                                                       | 1824150                                                                                      | 661291                                                                                        | 523804                                                                                               |
| 2025 | 101432603                                                                              | 34835261                                                          | 8089804                                                                             | 16324901                                                                                   | 19.76                                                                                       | 2769991                                                                                      | 1062888                                                                                        | 620896                                                                                               |
| 2026 | 102479125                                                                              | 43798589                                                          | 8089804                                                                             | 17926901                                                                                   | 23.83                                                                                       | 3739451                                                                                      | 1164122                                                                                         | 713692                                                                                               |
| 2027 | 103536455                                                                              | 52796686                                                          | 8089804                                                                             | 19529801                                                                                   | 27.95                                                                                       | 4743571                                                                                      | 1267622                                                                                         | 761698                                                                                               |
| 2028 | 104604705                                                                              | 61916553                                                          | 8089804                                                                             | 21132801                                                                                   | 32.11                                                                                       | 5790881                                                                                      | 1371432                                                                                         | 819698                                                                                               |
| 2029 | 105683988                                                                              | 71130565                                                          | 44628196                                                                             | 22735801                                                                                   | 36.31                                                                                       | 6868521                                                                                      | 1476242                                                                                         | 877698                                                                                               |
| 2030 | 106774417                                                                              | 80496456                                                          | 47612102                                                                             | 24338801                                                                                   | 40.56                                                                                       | 7988101                                                                                      | 1581052                                                                                         | 935698                                                                                               |
| 2031 | 107876108                                                                              | 89844776                                                          | 50168854                                                                             | 26041801                                                                                   | 44.90                                                                                       | 9140211                                                                                      | 1686462                                                                                         | 993598                                                                                               |
| 2032 | 98667187                                                                               | 97662370                                                          | 51447381                                                                             | 27744801                                                                                   | 49.36                                                                                       | 10305311                                                                                     | 1792872                                                                                         | 1051498                                                                                              |
| 2033 | 90429590                                                                               | 113497534                                                         | 53212073                                                                             | 29447801                                                                                   | 53.92                                                                                       | 11492411                                                                                     | 1900282                                                                                         | 1109498                                                                                              |
| 2034 | 91973950                                                                               | 124979544                                                         | 55078013                                                                             | 31150801                                                                                   | 58.51                                                                                       | 12679511                                                                                     | 2008792                                                                                         | 1167498                                                                                              |
| 2035 | 93544753                                                                               | 137758792                                                         | 57075013                                                                             | 32853801                                                                                   | 63.11                                                                                       | 13972111                                                                                     | 2118302                                                                                         | 1225498                                                                                              |
| 2036 | 94340212                                                                               | 149583802                                                         | 59171013                                                                             | 34556801                                                                                   | 67.71                                                                                       | 15274311                                                                                     | 2227812                                                                                         | 1283498                                                                                              |
| 2037 | 95142453                                                                               | 16278754                                                          | 61378013                                                                             | 36260001                                                                                   | 72.32                                                                                       | 16595711                                                                                     | 2337322                                                                                         | 1341498                                                                                              |
| 2038 | 95951534                                                                               | 17644246                                                          | 63576013                                                                             | 38064001                                                                                   | 77.03                                                                                       | 17925111                                                                                     | 2457832                                                                                         | 1399498                                                                                              |
| 2039 | 94767513                                                                               | 191080879                                                        | 65774013                                                                             | 39870001                                                                                   | 81.74                                                                                       | 19295511                                                                                     | 2580242                                                                                         | 1457498                                                                                              |
| 2040 | 922334135                                                                              | 206143063                                                         | 67972013                                                                             | 41676001                                                                                   | 86.45                                                                                       | 20675911                                                                                     | 2701752                                                                                         | 1515498                                                                                              |
| 2041 | 223334135                                                                              | 221206063                                                         | 69970013                                                                             | 43482001                                                                                   | 91.16                                                                                       | 22047111                                                                                     | 2823962                                                                                         | 1573498                                                                                              |
| 2042 | 236931467                                                                              | 236276063                                                         | 71968013                                                                             | 45288001                                                                                   | 95.87                                                                                       | 23570711                                                                                     | 2946172                                                                                         | 1631498                                                                                              |
| 2043 | 252475301                                                                              | 251276063                                                         | 73966013                                                                             | 47094001                                                                                   | 100.60                                                                                      | 24103311                                                                                     | 3071382                                                                                         | 1689498                                                                                              |

annual financing costs, using a discount rate of six percent. Columns 5 and 6 show the total amount of groundwater saved, each year, across both counties, by the RWH system in millions of gallons per year (MGY) and millions of cubic meters per year (Mm³Y), respectively. Column 7 shows the total annual water supply energy savings in kilowatt hours (kwh). Column 8 shows the total dollar amount of water supply energy saved each year. Column 9 shows the present values of the annual dollar amounts of water supply energy savings, using a discount rate of six percent.
Table 3 presents annual data on low projections for population growth and associated amounts of total water demand in Broward and Palm Beach Counties, in Florida. Column 1 shows the years of data, which extend from 2020 to 2060. Columns 2–5 show the low population projections for numbers of people and the corresponding amounts of total water demand in millions of gallons per day in Broward and Palm Beach Counties, respectively. Column 6 shows the combined amount of total water demand in millions of gallons per day in both Broward and Palm Beach Counties, together. Columns 7 and 8 show the amounts of total water demand in millions of cubic meters per day in Broward and Palm Beach Counties, respectively. Column 9 shows the combined amount of total water demand in millions of cubic meters per day in both Broward and Palm Beach Counties, together.

| Year | Low projections for Broward population | Low projections for Palm Beach population | Broward total water demand (MGD) | Palm Beach total water demand (MGD) | Total water demand Broward + Palm Beach (MGD) | Broward total water demand (Mm³D) | Palm Beach total water demand (Mm³D) | Total water demand Broward + Palm Beach (Mm³D) |
|------|--------------------------------------|------------------------------------------|----------------------------------|-------------------------------------|----------------------------------------|----------------------------------|----------------------------------|----------------------------------------|
Note, some water management projects are designed to meet the needs of just one county, while others are designed to meet the needs of multiple counties [1,2,6]. Thus, it can be useful to consider water demands at the level of the individual county, as presented in columns 4, 5, 7, and 8, as well as across both counties, as presented in columns 6 and 9. Broward and Palm Beach Counties are adjacent and there are significant links between the water supply systems in these counties. For example, recent reservoir-based water management systems have been designed to simultaneously meet the growing water supply needs of both Broward and Palm Beach Counties [1,2,6].

2. Experimental design, materials, and methods

The data presented Tables 1–3 in the present article were acquired and analysed as described in Wurthmann [1]. This section of the present article provides additional details concerning how the data shown in Tables 1–3 were acquired and analysed.

The data shown in Tables 1–3 are based on assumptions that the following items remain constant: 1. rates of water usage; 2. sizes of homes and lots; 3. numbers of people residing in homes; 4. breakdowns of the percentages of homes based on numbers of bedrooms; and 5. yearly ratios of numbers of single-family detached homes to numbers of people residing in Broward and Palm Beach Counties, Florida. It is also assumed that the energy intensity of water and costs will remain constant through 2060. These assumptions may not hold if there are changes in individual and societal perceptions and norms, or technological, political, legal, economic, and environmental factors. Accordingly, analysts may wish to consider the sensitivity of some of the data in the present article to potential changes in the underlying assumptions. For example, given the long-term nature of the data and particular susceptibility of the region to the effects of climate change, analysts might wish to consider how the data provided herein could be affected by outcomes including: 1. more heavy and sporadic rainfall events; 2. more intense drought-flood cycles; 3. higher average temperatures; 4. significant changes in perceptions, behaviors, regulations, and property values; and 5. potentially large-scale climate migration [1].

In Table 1, turn-of-decade values for populations shown in columns 2 and 3 were collected from secondary sources as raw data [2,3]. These turn-of-decade values were then used as the endpoints for calculating compound annual growth rates (CAGRs) to fill in population levels for each year, during each decade. The average ratios of numbers of detached houses to numbers of people, for the years 2010 through 2017, for Broward and Palm Beach Counties, were calculated from Census data as 0.181 and 0.221, respectively [1,4]. These ratios were multiplied by the population data in columns 2 and 3 to determine the numbers of detached homes in Broward and Palm Beach Counties shown in columns 4 and 5, respectively. Numbers of new detached homes created and to be fit with RWH equipment each year are shown in columns 6 and 7. These data were calculated as the year-to-year changes in the numbers of detached homes in Broward and Palm Beach Counties shown in columns 4 and 5, respectively.

The data shown in columns 8 and 9 in Table 1 were determined based on the following considerations. As per Wurthmann [1], meeting 100% of the outdoor irrigation needs of 142.43 gallons per day at single-family detached homes in Broward County only meets 39.2% of the total water needs at such homes. Note total household water needs were the product of the average number of residents per household, based on 2017 US census data [4], and per capita water usage data [1,2,6,7]. As per Wurthmann [1], per capita water usage was determined “by dividing actual 2010 water supply pumpage quantities by the corresponding figures for the populations using that water in Broward and Palm Beach Counties” [1]. The outdoor irrigation needs were calculated assuming an average area of yard in Broward County requiring irrigation of 3198.78 square feet and an average required amount of irrigation of 0.5 inches, once per week, year round [1,9–11]. Note, the average area of yard requiring irrigation was calculated as 50% of the difference between the average lot size and home square footage for the county of interest [1]. The average home square footage (and rooftop area) values for detached homes in Broward and Palm Beach Counties were determined to be 2223.45 and 2284.80 square feet, respectively [1]. These values were determined by multiplying the percentages of homes in the counties of interest, based on numbers of bedrooms [4], by data on the average square footage of homes for sizes corresponding to number of bedrooms [8]. Thus, for each newly created single-family detached household in Broward County that is equipped for RWH, 1.55 existing single-family detached
homes in Broward County must also be so equipped in order to offset the additional total water demand.

Similarly, meeting 100% of the outdoor irrigation needs of 233.04 gallons per day at single-family detached homes in Palm Beach County only meets 53.1% of the total water needs at such homes [1]. The outdoor irrigation needs were calculated assuming an average area of yard in Palm Beach county requiring irrigation of 5233.60 square feet and an average required amount of irrigation of 0.5 inches, once per week, year round [1,9–11]. Thus, for each newly created single-family detached household in Palm Beach County that is equipped for RWH, 0.88 existing single-family detached homes in Palm Beach County must also be so equipped in order to offset the additional total water demand. Further, since single-family detached homes in Palm Beach versus Broward County use more water in total and for outdoor irrigation, appropriate conversion factors were applied to determine equivalence between numbers of single-family detached households and water usage across the two counties.

The cost figures shown in Table 2 are based on the assumptions that the cost per household for installed RWH system equipment is $5000 and $10000 in Broward and Palm Beach Counties, respectively [1], the energy intensity of water is 2100 kwh/MG [14], and the cost of energy is $0.0758 per kwh [15]. The cost per household for installed RWH system equipment is based on the assumption that each household in Broward and Palm Beach Counties, respectively, is to be equipped with four and eight 2000-gallon, above-ground, plastic cisterns [1]. These equipment requirements were determined using a nonparametric bootstrapping method for synthetically generating daily precipitation, water supply, and irrigation demand for rainwater harvesting system storage sizing [1,16]. The cost components, on a per cistern basis, included $800 for the cisterns, $250 for all associated equipment (conveyance, filtration, disinfection, etc.), and $200 for installation labor [1,13]. Note, it is assumed that the costs of including RWH system equipment on new and existing homes is the same.

The data in column 2 in Table 2 were determined by multiplying the cost per household for installed RWH system equipment by the number of new and existing detached homes that must be fit or retrofit with RWH equipment each year from Table 1. The data in column 3 in Table 2 were determined by summing all required, annual level payment amounts for each year, in the period 2020 through 2060. It is assumed all annual total capital outlays required for the installation and replacement of RWH equipment are financed using 20-year schedules of level payments. The values in these schedules of level payments were determined by multiplying each annual capital outlay by the inverse of the annuity factor with an interest rate of six percent. Note, “it is assumed that all installed RWH system equipment must be replaced, at its initial installation cost, every 20 years” [1].

The data in column 4 in Table 2 were determined by multiplying the data in column 3 by a present value factor corresponding to a six percent interest rate. The data in columns 5 and 6 in Table 2 were determined by multiplying the total number of new houses fit and existing houses retrofit with RWH system equipment in Broward and Palm Beach Counties by the amounts of water used for landscape irrigation by households in those counties [1]. The data in column 7 in Table 2 were determined by multiplying the data in column 5 by a groundwater energy intensity value of 2100 kwh/MG [14]. The data in column 8 in Table 2 were determined by multiplying the data in column 7 by a cost of energy for Florida industrial customers of $0.0758 per kwh [15]. The data in column 9 in Table 2 were determined by multiplying the data in column 8 by a present value factor corresponding to a six percent interest rate.

In Table 3, the values for populations shown in columns 2 and 3 were determined as follows. The 2020 population projections for both Broward and Palm Beach Counties were the same as those shown in Table 1 (i.e. The populations in the two counties in the present time are assumed to be the same). From this common starting population level, the rate of change projections for low population growth, for future decades in Broward County are assumed to result in percentage changes in population “of –1.2% from 2020 to 2030, -2.2% from 2030 to 2040, and –3.3% for each of the remaining two decades” [1]. The rate of change projections for low population growth, for future decades in Palm Beach County are assumed to result in percentage changes in population “of 3.6% from 2020 to 2030, 1.6% from 2030 to 2040, –1.4% from 2040 to 2050, and 0% for 2050–2060” [1]. The turn-of-decade values were then used as the endpoints for calculating CAGRs to fill in population levels for each year, during each decade, for both Broward and Palm Beach Counties. The water demand data shown in the remaining columns in Table 3 were determine by multiplying population data by total daily per capita water
usage. It is assumed total daily per capita water usage remains constant at 130.97 and 169.56 gallons in Broward and Palm Beach Counties, respectively [1].

Additional information related to the materials, methods, and assumptions used to integrate data from multiple secondary sources to create the data presented Tables 1–3 in the present paper is provided in Wurthmann [1].

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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