

**CITY OF ZANESVILLE
STORMWATER UTILITY PROGRAM**

POLICY: ERU DETERMINATION

I. OVERVIEW

The JHA/ERC Team has been retained by the City of Zanesville to provide assistance in revising and implementing a successful and legally defensible stormwater utility program and stormwater billing master file that will include a stormwater database and impervious area measurements. As part of the overall process and approach, the JHA/ERC Team is developing a series of "Policy Papers" and "Billing Policy Papers" that will be used to document discussions and decisions made regarding various components of the stormwater utility program.

This is the third billing policy paper in a series of billing policy papers that documents the identification of properties within the City of Zanesville stormwater service area (city limits), assigning each parcel/property a land use code of either SFR (single-family residential) or NON (non-residential) or VAC (vacant and undeveloped), measuring the impervious area for all non-residential properties, calculating the number of Equivalent Residential Units (ERUs) for those non-residential properties, and determining the rate of charge per ERU per month for all properties in the City. This "amount to bill" will then be transferred to the City of Zanesville who will be responsible for merging and integrating the JHA/ERC Team's stormwater database created as part of the process into the existing water and sewer utility billing system for billing stormwater under the ERU rate structure method based approach.

During later phases of this project, the JHA/ERC Team will measure the impervious area for all developed (properties that contain impervious area) non-residential properties, and calculate the number of ERUs and resulting stormwater user fee charge. Properties with no impervious area will not be assigned a stormwater fee. A statistically representative random sample of single-family residential properties has been measured in order to develop the square footage value of the equivalent residential unit (ERU). **The ERU determination is the topic of this billing policy paper.**

This process will enable the City to effectively incorporate the stormwater billing information into the current utility billing system database, and begin billing customers under a legally defensible stormwater utility program in the most cost effective manner possible based on the generally accepted ERU rate structure method that has been upheld in state supreme courts and deemed as legally defensible.

DISCUSSION:

The primary steps involved in determining the Equivalent Residential Unit (ERU) for the City of Zanesville Stormwater Utility have been as follows:

- Generate a random sample of residential properties from an existing parcels database file;
- Identify the impervious area within each property;
- Digitize (measure) the amount of impervious area within each property;
- Estimate the population ERU from the sample ERU;
- Perform a statistical analysis on the data to determine the 95% confidence level and 5% confidence interval. This will determine the number of adequate samples to validate the estimate used for the population ERU.

GENERATE RANDOM SAMPLE

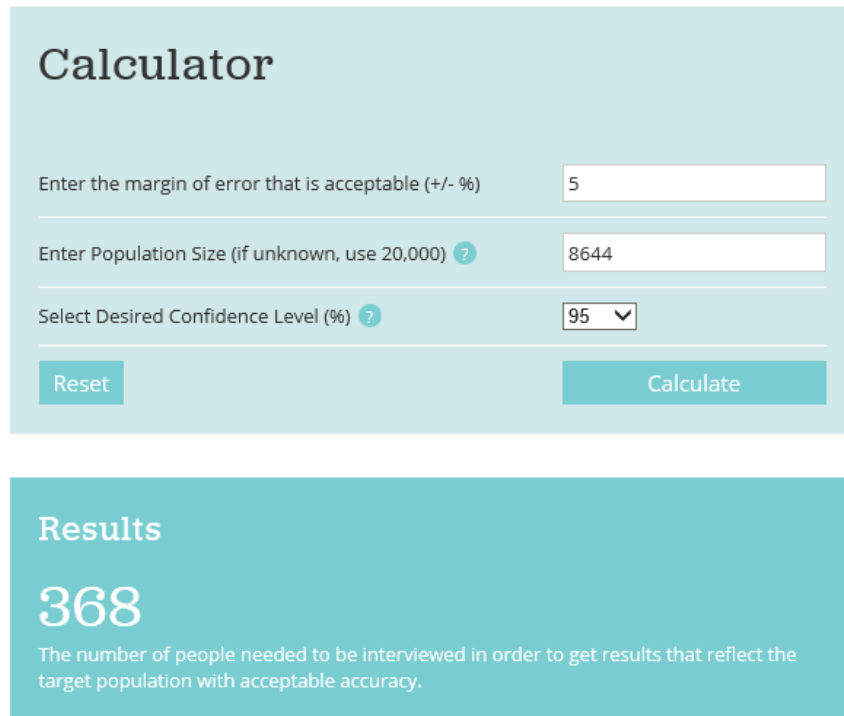
City staff and the JHA/ERC Team held meetings relating to two specific billing issue policies. The consensus reached in defining residential properties included the following land use categories:

- Single-family residential properties; and
- Two-family or duplex properties.

All properties from these land use categories were used to generate a random sample to determine the average impervious area. The JHA/ERC Team used the Muskingam County GIS parcel database containing 57,009 land parcels (properties). The parcels located within the City of Zanesville were extracted from this file. The extracted file contained 11,984 records. All properties with a land use class code of “510” (single-family), “511” (single-family) and “520” (two family) were extracted from the second file. The file containing only single-family and two family parcels contained 8,644 records. Each of the 8,644 records were randomized and then assigned a random number using a Microsoft Excel™ data analysis add-in. The minimum sample size was then determined to be 368, but the Project Team sampled 402 records to account for the maximum sample size needed if population is unknown. Once this selection was completed, a sample record number was assigned to each parcel.

A table has been provided in the Appendix, which shows various samples sizes for a variety of different population sizes.

The chart below was also used to calculate the sample size. This interactive chart can be found on the McCallum Layton Company website located at the following URL: <https://www.mccallum-layton.co.uk/tools/statistic-calculators/sample-size-calculator/>



Calculator

Enter the margin of error that is acceptable (+/- %)

Enter Population Size (if unknown, use 20,000)

Select Desired Confidence Level (%)

Results

368

The number of people needed to be interviewed in order to get results that reflect the target population with acceptable accuracy.

Confidence Level

Confidence level tells how certain the project team is that the results are accurate. It is expressed as a percentage (over 95% for this sample) and represents how often the true percentage of the population is represented in the sample and lies within the confidence level. In this case, the project team requires a minimum of 95% certainty.

IDENTIFY IMPERVIOUS AREA

The Muskingum County Geographic Information System database and base mapping system and aerial photography were used to identify and measure the properties through the use of County Tax parcel ID numbers included in the database. The impervious areas were identified through use of aerial photography covering the City of Zanesville.

ESTIMATE POPULATION ERU

To estimate the population ERU the sample mean and standard deviation were calculated and the results shown below:

Sample mean (x) = 2,311.09 sq. ft. of impervious surface

Standard deviation (σ) = 1,375.79

Number of Samples = 402

$\alpha = 0.05$ (at 95% confidence)

Confidence Interval

The 95% confidence interval was found to be in a range between of +/- 29.0 of the mean, or between 2,232.09 sq. ft. and 2,340.09 sq. ft. of impervious area. This translates into a 95% confidence that the true population mean is within the stated range. Theoretically, the City of Zanesville Stormwater Utility can use any one number between the confidence intervals to represent the ERU. The lower number (2,282 sq. ft.) would generate more Equivalent Residential Units (ERUs) due to the effect on non-residential properties. On the other hand, the higher number (2,340 sq. ft.) would generate a lower number of ERUs. However, the Project Team believes the impact on revenues will be insignificant and the decision should center on ease of implementation. Application of 2,300 sq. ft. representing one ERU appears to be more practical since it is more representative of the actual sample mean of 2,311 sq. ft.

Calculator

Enter Sample Size ?

Enter Sample Observed Mean ?

Enter Sample Observed Standard Deviation ?

Select Desired Confidence Level (%) ? ▼

Reset
Calculate

Results

Confidence Interval:
±29

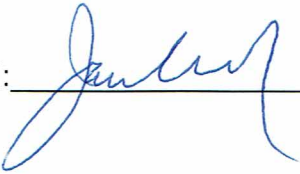
Range for the true population mean:
2282.09 to 2340.09

RECOMMENDATION:

The JHA/ERC Team recommends that the City of Zanesville Stormwater Utility utilize 2,300 square feet of impervious area to represent one (1) Equivalent Residential Unit (ERU).

ACTION:

The TAC reviewed, discussed and approved this billing policy paper during the April 21, 2016 TAC meeting.

Approved: 

Date: 4/21/16

APPENDIX

Sample Size Table

TABLE FOR DETERMINING NEEDED SIZE S OF A RANDOMLY CHOSEN SAMPLE FROM A GIVEN FINITE POPULATION OF N CASES SUCH THAT THE SAMPLE PROPORTION p WILL BE WITHIN $\pm .05$ OF THE POPULATION PROPORTION P WITH A 95 PERCENT LEVEL OF CONFIDENCE

Population Size	Sample Size	Population Size	Sample Size	Population Size	Sample Size
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000	384

PARCEL ID	IMP AREA
81-01-04-03-000	1310.44754
81-02-02-01-000	2551.3291
81-02-02-05-000	2000.11688
81-02-03-03-000	4297.76502
81-02-03-13-000	3165.50966
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81-02-04-11-000	2719.19365
81-03-02-16-000	1349.70926
81-03-02-18-000	2288.16054
81-03-02-19-000	3322.20272
81-03-02-22-000	1678.05805
81-03-02-24-000	1544.7016
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82-17-01-17-000	2269.24599
82-17-02-17-000	2679.01009
82-17-02-24-000	2168.90014
82-21-02-28-000	2739.74361
82-21-02-38-000	2279.18484
82-21-03-05-000	2544.36809
82-21-03-10-000	1851.11693
82-21-03-18-000	3936.07235
82-21-03-36-000	2080.48209
82-21-04-13-000	2296.09044
82-26-02-09-000	2146.37621
82-26-02-11-000	1841.55459
82-26-03-26-000	2151.10332
82-28-01-22-000	3465.51921
82-28-02-15-000	2957.6351
82-29-01-01-000	2100.24026
82-29-01-03-000	3728.44826
82-29-01-13-000	1529.91017
82-29-01-27-000	1503.40678
82-29-01-29-000	3344.12313
82-29-02-05-000	2953.44509
82-29-02-08-000	3253.46196

82-29-02-17-000	2612.59996
82-30-01-17-000	1413.9842
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82-30-02-17-000	2216.35679
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82-30-03-25-000	2209.22654
82-30-03-29-000	1936.01228
82-30-03-30-000	1948.33258
82-33-01-18-000	743.803635
82-33-01-20-000	1698.02844
82-33-02-07-000	1707.0355
82-33-02-26-000	1605.47484
82-34-02-10-000	1389.90696
82-34-03-13-000	1920.77425
82-34-03-14-000	2235.95268
82-34-04-08-000	1875.54594
82-34-04-15-000	1907.34761
82-34-04-18-000	1604.10929
82-34-05-01-000	2123.27392
82-34-05-13-000	2781.4205
82-34-06-25-000	1457.357
82-35-01-16-000	1432.69992
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82-35-03-10-000	3081.42392
82-35-04-20-000	1437.5312
82-35-05-14-000	3729.30377
82-36-06-18-000	891.663995
82-36-06-20-000	1928.94313
82-37-01-05-000	2049.80675
82-37-01-07-000	1346.1772
82-37-02-02-000	1289.19251