

Evaluating the Effectiveness of the San Antonio Tree Preservation Ordinance: Some Preliminary Findings

By

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ISSUE: Trees are a critical part of the urban ecosystem. Urban forestry studies¹ demonstrate that trees serve as a component of stormwater management (slowing runoff and resulting water pollutants), remove pollutants from the air, and, when properly sited, can substantially reduce the costs of energy needed by homes and businesses. Achieving a healthy urban forest is the result of a management system involving the integration of voluntary and regulatory activities, such as tree maintenance and planting programs, educational and awards programs, and governmental regulatory and incentive programs.² One of the key components of an urban forest management system is an effective tree preservation ordinance (TPO).

The San Antonio TPO has been controversial since enacted in 1997; even supporters question its effectiveness at meeting the statutory goal of preserving trees. One of the challenges to the effectiveness of this regulation has been a Texas state property rights law that allows some properties to be “grandfathered” or vested from compliance with the tree ordinance. This issue brief compares pre- and post-development tree canopy on vested and not-vested commercial building projects constructed from 2003-2004. If the TPO has been effective at achieving its statutory goal of preserving trees, not-vested projects should show more preservation of tree canopy and greater total tree canopy on site than vested projects.

DATA AND METHODS: This study measures the change in tree canopy from a pre-development to a post-development condition on 43 commercial building project sites for the time period between April 2003 and December 2004.³ Using aerial imagery at six-inch resolution produced in 2001 and 2005 and overlay files (to include Bexar Appraisal District parcels and a geocoded file of the commercial building permits) building projects were identified in ArcMap 9.1 (GIS), irregular polygons were drawn around tree canopy on each building parcel, and the total square feet of pre- and post-development canopy area was automatically calculated.⁴ Trees planted after development were also counted (often accompanied by a site visit to verify the number and size of mitigated trees; eight cases not completely landscaped in the 2005 imagery) and the total diameter inches of mitigated trees were converted into tree canopy using a conversion formula provided by the City of San Antonio’s Arborist.⁵ Pre- and post-development canopy measurements were then calculated, with mitigation canopy calculated separately and added to post-development preserved canopy to yield total post-development canopy. Finally, the change in canopy was calculated, both in total square feet of canopy change and as a percentage of the area of the parcel, to control for variation in parcel size among cases. Independent sample means tests were applied to compare the characteristics of the vested and not-vested cases.

FINDINGS: Of the cases examined, seventeen were vested and twenty-six were not-vested.⁶ While 30% of projects maintained or gained canopy (one project mitigating as much as 10% canopy), there is a net loss of seventy-three (73) acres of canopy over

the total data set. Vested projects show an average size of four acres and not-vested projects an average size of six acres. Table 1 reveals that there are significant difference between vested and not vested projects in the average percentage of total post-development (preserved + mitigated) canopy (prob.=.03) and in the percentage of preserved canopy (prob.=.02). The average post-development tree canopy in vested projects was 8% of parcel area, while the average tree canopy in not-vested projects was 17% of the parcel area. Further, vested projects preserved just 7% of the parcel area in canopy, while not-vested projects again preserved an average of 17% of the parcel area in canopy.

TABLE 1 –Comparison of the Means (t-test for Equality of Means) for Percentage Post-Development and Preserved Canopy

| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference |
|--|-----------------------------|-------|-------|-------|------|-----------------|-----------------|
| Percent of parcel area in post-development canopy (preserved + mitigated) | Equal variances assumed | 5.716 | 0.022 | 1.919 | 40 | 0.062 | 8.63% |
| | Equal variances not assumed | | | 2.268 | 36.9 | 0.029 | 8.63% |
| Percent of parcel area in preserved canopy | Equal variances assumed | 5.098 | 0.029 | 2.024 | 40 | 0.050 | 9.357 |
| | Equal variances not assumed | | | 2.372 | 37.8 | 0.023 | 9.357 |

OBSERVATIONS: This investigation of available data suggest that San Antonio's TPO has been effective at achieving its statutory objective of preserving trees and of increasing the percentage of post-development tree canopy on commercial building sites. Preliminary findings demonstrate that commercial projects that were required to comply with the provisions of the tree preservation ordinance did, in fact, preserve more trees than projects vested from compliance. Most importantly, the tree preservation ordinance appears to have created an environment where even vested projects demonstrate substantial tree planting behavior to mitigate for trees lost.

APPENDIX A

Descriptive Statistics

| | VESTED STATUS | N | MEAN |
|--|----------------------|----------|-------------|
| PRE-DEVELOPMENT CANOPY IN SQUARE FEET | NOT VESTED | 26 | 62481.48 |
| | VESTED | 16 | 27801.65 |
| PERCENT OF PARCEL AREA IN PRE-DEVELOPMENT CANOPY | NOT VESTED | 26 | 25.91% |
| | VESTED | 16 | 23.44% |
| POST-DEVELOPMENT CANOPY IN SQUARE FEET (PRESERVATION + MITIGATION) | NOT VESTED | 26 | 41612.04 |
| | VESTED | 16 | 11037.29 |
| PERCENT OF PARCEL AREA IN POST-DEVELOPMENT CANOPY (PRESERVATION + MITIGATION) | NOT VESTED | 26 | 17.05% |
| | VESTED | 16 | 8.42% |
| CANOPY CHANGE (GAIN/LOSS) IN SQUARE FEET | NOT VESTED | 26 | -20869.43 |
| | VESTED | 16 | -16764.36 |
| PERCENT CHANGE IN CANOPY | NOT VESTED | 26 | -8.86% |
| | VESTED | 16 | -15.02% |
| MITIGATION CANOPY IN SQUARE FEET | NOT VESTED | 26 | 1317.09 |
| | VESTED | 16 | 1671.76 |
| PRESERVED CANOPY IN SQUARE FEET | NOT VESTED | 26 | 40294.95 |
| | VESTED | 16 | 9365.53 |
| PRESERVED CANOPY AS PERCENT OF PARCEL AREA | NOT VESTED | 26 | 16.56 |
| | VESTED | 16 | 7.20 |
| TOTAL VALUATION IN DOLLARS (LAND+IMPROVEMENT) | NOT VESTED | 21 | 1310694.29 |
| | VESTED | 14 | 2824803.93 |
| PARCEL AREA | NOT VESTED | 26 | 267084.23 |
| | VESTED | 16 | 154707.76 |

APPENDIX B

Independent Samples Test of Variables Comparing Vested and Not-Vested Cases

| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference |
|---|-----------------------------|-------|-------|--------|--------|-----------------|-----------------|
| PRE-DEVELOPMENT CANOPY IN SQ FT | Equal variances assumed | 2.247 | 0.142 | 0.993 | 40 | 0.326 | 34679.8 |
| | Equal variances not assumed | | | 1.212 | 32.754 | 0.234 | 34679.8 |
| PERCENT OF PARCEL AREA IN PRE-DEVELOPMENT CANOPY | Equal variances assumed | 2.226 | 0.144 | 0.314 | 40 | 0.755 | 2.47% |
| | Equal variances not assumed | | | 0.296 | 26.094 | 0.769 | 2.47% |
| POST-DEVELOPMENT CANOPY IN SQ FT (PRESERVED + MITIGATED) | Equal variances assumed | 7.496 | 0.009 | 1.561 | 40 | 0.126 | 30574.7 |
| | Equal variances not assumed | | | 1.961 | 28.112 | 0.060 | 30574.7 |
| PERCENT OF PARCEL AREA IN POST-DEVELOPMENT CANOPY (PRESERVED + MITIGATED) | Equal variances assumed | 5.716 | 0.022 | 1.919 | 40 | 0.062 | 8.63% |
| | Equal variances not assumed | | | 2.268 | 36.922 | 0.029 | 8.63% |
| TOTAL SQUARE FEET OF CANOPY CHANGE (GAIN OR LOSS) | Equal variances assumed | 0.646 | 0.426 | -0.166 | 40 | 0.869 | -4105.0 |
| | Equal variances not assumed | | | -0.198 | 36.148 | 0.844 | -4105.0 |
| PERCENT CHANGE IN CANOPY | Equal variances assumed | 3.102 | 0.086 | 1.012 | 40 | 0.318 | 6.16% |
| | Equal variances not assumed | | | 0.92 | 23.211 | 0.367 | 6.16% |
| MITIGATION CANOPY IN SQUARE FEET | Equal variances assumed | 0.088 | 0.768 | -0.404 | 40 | 0.688 | -354.6 |
| | Equal variances not assumed | | | -0.458 | 39.844 | 0.650 | -354.6 |
| PRESERVED CANOPY IN SQUARE FEET | Equal variances assumed | 7.826 | 0.008 | 1.587 | 40 | 0.120 | 30929.4 |
| | Equal variances not assumed | | | 1.993 | 28.147 | 0.056 | 30929.4 |
| PERCENT OF PARCEL AREA IN PRESERVED CANOPY | Equal variances assumed | 5.098 | 0.029 | 2.024 | 40 | 0.050 | 9.4 |
| | Equal variances not assumed | | | 2.372 | 37.806 | 0.023 | 9.4 |
| AREA OF PARCEL IN SQ FT | Equal variances assumed | 3.966 | 0.053 | 1.025 | 40 | 0.311 | 112376.5 |
| | Equal variances not assumed | | | 1.232 | 34.875 | 0.226 | 112376.5 |
| TOTAL VALUATION IN DOLLARS (LAND+IMPROVEMENT) | Equal variances assumed | 8.139 | 0.007 | -1.973 | 40 | 0.055 | -1413069.1 |
| | Equal variances not assumed | | | -1.708 | 19.894 | 0.103 | -1413069.1 |

NOTES

¹Akbari et.al. 1992, Toner 1987, Petit et.al. 1998, Jackson 2002, and McPherson 2003.

²Akbari et.al. 1992

³Representing 14% of total building permits for the time period under examination.

⁴Polygons were drawn and area calculated with a third-party extension of ArcMap called XTools.

⁵ A formula used by the City Arborist to calculate the canopy area of tree stand was reversed to calculate the amount of canopy that mitigated trees contributed to the total post-development canopy. The shade value of the species of tree planted is a component of the formula. Shade values of tree species in South Texas range from 275 square feet for full-grown ornamental and small-species trees up to 1200 square feet for varieties of sycamore and cypress. The City Arborist recommended a mid-range shade value factor of 575 square feet to represent the variety of mitigated trees planted. To calculate the mitigation canopy, the number of new trees was tallied, and an assumption was made that each tree was two inches dbh (diameter at breast height). The total number of dbh inches was calculated then divided by a constant representing the number of dbh of a full-grown specimen of the predominant species corresponding to the shade value chosen to apply to the site. The resulting number of equivalent full-grown trees was then multiplied by the shade value to yield the amount of mitigation canopy resulting from the trees planted. The formula is: {Diameter inches mitigated (planted)/Average diameter of full-grown tree (by species)} x Shade Value by Tree Species (square feet) = Canopy (square feet)

⁶ Appendices A and B provide descriptive statistics and independent-samples t-tests for the cases studied. The difference in the percentage of tree canopy before development for vested (23%) and not-vested projects (25%) were not statistically significant {prob.=.755}. Given the sample size of the data set, one outlier (the La Cantera Shopping Center, which represented 36% of the total acreage of the all the cases examined) was identified and eliminated.