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"Housing Sustainability, Self-help and Upgrading in Texas *Colonias*: A Longitudinal Perspective -- 2002 plus 10"

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Report # 1.

Documenting a Decade of Lot Occupation Change in 22 Texas County Colonias and Subdivisions: Satellite Image Analysis Design and Results

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EXECUTIVE SUMMARY

The purpose of this report is twofold. First, we seek to provide future researchers with a guidebook for an easily reproducible method for capturing, analyzing, and comparing lot-level occupation changes in multiple communities, over time.

In this method relevant data is collected through a lot-level system for coding satellite images in Google Earth and through county tax appraisal searches. Data collection is divided into three general phases. In the first phase – lot coding – researchers capture lot-level occupation changes across multiple satellite images by adding and adjusting Google Earth placemarks according to the placemark coding system shared in this report. In the second phase – generating the "Hard" counts – researchers tally placemark counts for each of the study communities and enter them into the database (discussed below) for later analysis. In the third phase – ownership searches – researchers use tax appraisal websites to collect ownership information for vacant lots in the most recent satellite image, similarly marking the lots according to the placemark coding system in this report and adding tallies to the database. The Methodology section of this report provides general instructions and useful tips for each of the three coding phases. A more detailed "Data Collection and Analysis Guide", with images, is included in the appendix to assist any researchers in applying this method.

The data derived from this method can be analyzed exclusively in Excel. The report package includes a master database to ease data entry and analysis. The database requires very limited actual data entry as most of the columns and rows automatically generate figures based on built-in formulas. The Methodology section of the report provides general information about the Master Database's contents and a brief discussion of analysis tools and tips in Excel. More detailed instructions for using, adjusting, organizing and analyzing information in the database is provided in the "Data Collection and Analysis Guide".

In addition to the Data Collection and Analysis Guide this report package includes two workbooks: the "Lot Occupation Study Workbook" and a "Master Template Workbook". The study workbook contains the study database (first sheet) and a number of other sheets with the separate calculations that inform this report. The master workbook contains a template database, based on the study base, for future researchers to populate when applying this method.

The second purpose of this report is to share findings from analysis of occupancy changes over the past decade in 22 informal homestead subdivisions in Texas. The key purpose of this longitudinal study is to further a discussion about the challenges and opportunities for community consolidation initiated in the principal investigator's earlier research (see Ward et al 2000). However, since the methods used to examine these occupancy changes are based primarily on the general method shared in this paper, the longitudinal study also serves as an example of how the method may be applied.

As outlined in the introduction and overview offered by Dr. Ward this sequence of reports, *colonias* and so-called "Informal Homestead Subdivisions" began to develop in Texas during the

1960s and 1970s. Sold and purchased informally, the lots in these communities were often characterized by clouded titles/ownership and substandard services and infrastructure. Over the past 20 years Texas legislation has attempted to prevent the informal development of these communities. However, this study, aligning with several previous works (Ward 1999; 2003; Ward et al 2000), considers colonias and informal homestead subdivisions to be a rational response to poverty that provides a route to homeownership. Thus, beyond regulating the informal activities that lead to the creation of these settlements, we believe that policy should work to further consolidate and upgrade these settlements.

Fieldwork lead by the principal investigator in the late 1990s (Ward et al 2000) identified low occupancy levels – often ranging from 30-60% of all lots - as a central challenge to settlement consolidation and improvement. Indeed, low occupancy results in higher servicing and infrastructure improvement costs and limits the potential for community-based businesses and community organization for self-help. Fieldwork also found that many of the unoccupied lots had in fact been sold; many of the unoccupied lots belonged to absentee owners. Large numbers of unoccupied lots and high rates of absentee ownership further stymied development in these settlements by negatively affecting the efficient functioning of the land and housing markets.

Our study returns to the question of occupancy levels, seeking to understand if and how occupancy changed in the 20 previously studied communities (Ward et al 2000) and two additional recently surveyed communities (see *Housing Conditions, Sustainability and Self Help in Rancho Vista and Redwood Informal Homestead Subdivisions in Central Texas* www.lahn.utexas.org [click on Texas Housing Databases and got to the Rancho Vista and Redwood Study). Due to satellite image limitations, researchers combined satellite image data with data from a previous study directed by the principal investigator (see Ward et al 2000). Thus, this study provides a useful example not only of how to apply the method for satellite image analysis, but also of how the method can be combined with other data sources to expand analysis - such as Google Earth™ for example.

The longitudinal study of occupation in these 22 informal homestead subdivisions yields several notable findings.

Principal Findings:

1) Overall occupancy increased by 13% from 2000-2010, and vacancy levels were reduced to less than 30% in all but one settlement.

2) Modest overall increases occurred during each of the three “snapshot” periods analyzed (2000-2002; 2000-2006; and 2007-2010), ranging from 5.2 % in the first period to 3.1% in the latter. There does appear to have been some slight slowing in lot occupations since the housing crisis in 2007-2008.

3) The occupation increase was not a linear process. Rather, net growth involved considerable churn or turnover as some lots were vacated and other lots vacated and then re-occupied. Overall, the net loss was lower than the net inflow, and some of the losses were replaced what we call Re-infill (i.e. occupation of previously vacated lots). Of the two time periods that could be analyzed from this perspective, the highest levels

of Infill occurred during period B (i.e. between the first and second images) when 20% of vacant lots were occupied, compared to 17% during period C (2006-2010). Both periods also saw some outflow (1.2-1.3% of all lots), but the most recent period (2006-2010 or time horizon C) also saw a higher level of renewed outflow or exiting. Twenty-six percent of the newly occupied lots in the period from 2002-2006 were again vacated between 2006-2010 period. These findings alert us to the fact that there is rather more market turnover than previously recognized, although we have little clear idea of what is driving these changes or how they may vary according to individual colonia or subdivisions characteristics.

4) These changes and turnover notwithstanding, the large majority of formerly vacant lots remained vacant throughout the past decade. Absentee lot ownership remains high: in 2010 almost 20% of over 11,000 lots viewed had never been occupied, representing high opportunity costs for non-development and abandonment. Whether these vacant lots are effectively in the market place or locked out because of owner abandonment or foreclosure for lack of taxes is not known.

5) Of these 20 percent of vacant lots today relatively few (6%) are held by the developers; while 20% appear to be the result of lot combinations – mostly informal combination of adjacent lots by a single owner. Again, however, we know little about whether these are active in the market and/or are held for other kin.

Part 1. Introduction & Overview

This report is one of three principal deliverables arising from the Ford Foundation research project described by the Principal Investigator in the introductory overview (see also Reports #2 and #3 by Durst and Olmedo, respectively). Directed by Professor Peter Ward, the research informing this report was carried out by three graduate students from the University of Texas at Austin: Noah Durst (Latin American Studies/ Lyndon B. Johnson School of Public Affairs), Liana Hervas (Latin American Studies), and Danielle Rojas (Latin American Studies/Community and Regional Planning). Over the 2010-2011 academic school year, the research team created and employed a lot-level satellite image coding system that enables researchers to compare and contrast lot occupation changes across low-income colonia and informal subdivision communities.

As we report elsewhere in greater detail (Report # 2, chapters 2 & 3), the Attorney General of Texas website defines a colonia as a "substandard housing development, often found along the Texas-Mexico border, where residents lack basic services such as drinking water, sewage treatment, and paved roads" (Attorney General of Texas, 2011). The Attorney General's Office maintains geographic and descriptive information on over 1,800 colonias in 29 Texas counties in its "Colonia Geographic Database".[1] However, many "colonias" are neither a border nor a Texas phenomenon. Today it is recognized that colonias have existed throughout the southwest for over 60 years and that many similar types of subdivisions can be found well beyond the border in Georgia, Minnesota. North Carolina and other states (Ward and Peters 2007). In Texas, colonia type subdivisions may be found in the rural hinterland of central Texas cities, as well as outside of Dallas, Fort Worth, Houston, and even Lubbock in the north. In these areas the term "colonia" - a Spanish word for neighborhood – is an inappropriate nomenclature even if populations living in these communities remain largely of Hispanic of Mexican origin (Ward et al, 2000, pg. 14). Moreover, the frequent association of colonias with extreme poverty and substandard living conditions, as in the previous definition taken from Attorney General's website, may inaccurately characterize and/or stigmatize the community and residents in question. For these reasons we prefer the term "Informal Low-Income Subdivisions" to describe such settlements (Ward and Peters, 2007). Throughout this report we will use both terms, but colonias will usually refer to settlements and communities that are in the border and are so classified by the Attorney General's office; and Informal Homestead Subdivisions (IfHSs) where they data pertain to the settlements away from the border.

Over the past 20 years Texas legislation has attempted to prevent the development of colonias. In general these strategies include requiring developers to provide basic infrastructure in new residential developments (e.g. water, roads, and sewer), restricting the sale of un-platted lots and lots lacking water and/or sewer connections, limiting utility connections in substandard areas, and establishing protections for lots sold through contract for deed – an installment based seller financing agreement in which the seller retains the legal title until the payments have been completed (Ward 1999). (For a more detailed discussion of the legislation related to colonias, see https://oag.state.tx.us/consumer/border/history.shtml.)

[1] Link to the Attorney General's Colonia Geographic database: https://maps.oag.state.tx.us/colgeog/colgeog_online.html#app=a527&1d99-selectedIndex=1

Several previous studies (Ward 1999, 2003; Ward et al 2000) have argued that instead of focusing solely upon trying to regulate the many informal activities that lead to the creation and expansion of colonias and IfHSs, self-managed low income housing developments should be seen as a rational response to poverty that provides a route to home ownership. This argument, and the policy approaches that might be adopted, were first outlined by Ward in his *Colonias and Public Policy in Texas and Mexico* volume (1999), and form much of the basis for the research that is presented here as part of the Ford Foundation sponsored study. Specifically for the current analysis and report, Ward's research and fieldwork in the late 1990s showed that many of the colonias and subdivisions had very low densities as a result of relatively large lot sizes (1/2 to 1 acre lots often), and especially due to the low levels of lot occupancy that were often observed in a single settlement. Indeed, it was not uncommon to find that anything between 30-60% of lots were unoccupied, or put another way, that the lots were owned by absentee lot owners. Often these settlements were sold-out but not built (or occupied) out.

The extent and reasons for non–occupancy was the focus of an earlier study and report (Ward et al 2000) which form the precursor to the present analysis; the policy argument that they made was that low population and lot occupancy levels constituted a central challenge for further consolidation and upgrading of these settlements. Low densities hinder effective infrastructure provision (both physical and social), as well as other capital investments, and generally work to stymie the land and housing market (Ward et al 2000). Specifically, the dispersed development pattern often found in colonias/IfHSs results in much higher servicing costs, hindering the feasibility of community infrastructure improvements. Associated low social densities limit the potential for community based organization and self-help and mutual aid programs, as well as hindering productive activities such as micro enterprises, commercial Mom and Pop stores and the introduction of services, such as public transportation and garbage collection.

This report returns to the question of occupancy levels in Texas colonias, examining many of the same communities from the 2000 study over a ten year period. The main objective of this current study is to develop and apply an easily reproducible method for tracking, recording, and analyzing detailed, lot-level occupancy changes over time. The bulk of data that we use is drawn from satellite image analysis available in in Google Earth™. But wherever possible, we use the Ward et al 1990s data as a baseline from which to build the larger, longitudinal study of occupancy changes. Satellite images from the study year – 2000 – and earlier dates were often unavailable or difficult to analyze, so including the previous study data enabled us to extend the period of our analysis. Thus, using the Ward et al vacancy level data in addition to satellite image analysis, this report will examine lot occupancy changes in 22 Texas colonias and IfHSs for the period 2000 to 2010.[2]

This report contains four sections. The following **Methodology** section discusses each step in the satellite image coding and the data collection process, as well as guidance and a number of "tips" intended to facilitate reproduction in further studies. This discussion is divided into three data gathering phases: i) lot coding, ii) hard counts, and iii) downstream ownership searches using County Appraisal data primarily. The Methodology section also provides a brief review of the study and master databases created in Excel to store and analyze data and describes some Excel tools that facilitate data analysis. In addition to the study and master database workbooks, a "Data Collection and Analysis Guide" is included in the report package. The guide provides more detailed step-by-step instruction with images. The reader may wish to skip some sections

[2] Due to data constraints occupancy change in three of the colonias are only traced from 2002-2010 (Deerfield Park, Rancho Vista, and Brookhollow Estates).

of the Methodology since they are primarily intended to provide a guidebook to researchers who wish to use our method for their own research.

After outlining the method the **Case Study Communities** section introduces and describes the study colonias/IfHSs, as well as the counties where they are located. Data on each community's individual occupancy changes over the past decade are also included. A third **Findings** section primarily explores aggregate data. Occupancy changes are examined from several different analytical lenses: overall changes; by different periods or time horizons; and for turnover or what we will refer to as "churn". The findings section also further investigates vacancies at the time of study (i.e. in 2010) through a review of ownership data. Suggestions for future research are included throughout the report. However, future research suggestions and potential policy implications are brought together in the final **Discussion** section of the report.

Part 2. The Methodology, Database Construction, and the Study Communities

Providing an information rich aerial view of the past, satellite images are a novel and valuable tool for studying community change. However, drawing comparable, longitudinal data from the images requires an organized and efficient system for analysis. Creating a reproducible and readily accessible research and data gathering method, particularly with regards to cost, was a central goal for the research team. With this in mind, we began by searching for an appropriate source for the images. In the past, public access to satellite and aerial imagery was limited and often expensive. Today, due to advances in geospatial technologies, such images are much more accessible. Indeed, many companies, such as MapQuest, Google Maps, Bing, etc., provide extensive online public mapping services to assist individuals' driving directions and search behaviors. The maps often include the satellite and aerial images upon which they are based. However, most websites provide images from only a single date, preventing longitudinal analysis.

Available for free download, Google Earth™ is a more advanced geospatial information program with several features that facilitate satellite image analysis. The program provides users with a virtual globe that combines map and geographical information. Google Earth's historical imagery tool (on the menu bar) not only provides images from various dates, it also allows users to switch quickly between the available images. In addition, Google Earth provides a variety of inserting "placemarks" that can be used to tag or code an image. The placemarks can be labeled, adjusted in size, and can hold notes for later reference. Most importantly, the placemarks placed in one image appear in the following image of the same community and vice versa, permitting researchers to follow occupation changes in a specific lot over time. Accessibility and extensive features like those mentioned above, made Google Earth the ideal tool with which to build a method for analyzing occupation changes in a community.

In Google Earth, researchers selected three images from three distinct time periods to code and analyze for each of the 22 colonias. Image dates and resolution sometimes varied notably, however. To the degree possible, researchers selected images from three years: 2002, 2006, and 2010.[3] Data collection was then divided into three phases: individual lot review and coding; calculations of hard counts; and ownership searches. In the first phase researchers systematically scanned images and, denoting the lots as either occupied (O) or vacant (V), used color-coded placemarks to represent different lot occupancy combinations over time. For

[3] Ultimately, though, many of the images for the third time period came from 2009.

example, a lot that was occupied in 2002 and 2006, but vacant in 2010 would appear as OOV. In the second phase researchers conducted total lot counts and tallied and combined specific placemark totals for later analysis. In the third phase, researchers used tax appraisal data to identify individuals who were listed as owners and paying taxes on the vacant lots in the most recent image (2010). The following sections discuss the system that we developed and provide a number of general "tips" for future researchers interested in collecting and analyzing similar data.

Phase One – Lot Coding

In phase one, team members reviewed satellite images and tracked individual lot occupancy changes with a series of color-coded placemarks. Beginning with the first image (2002), the researcher scanned each street for vacant lots, marking them with the initial placemark (red, with a black square). Using the subsequent (later) images, researchers changed the previous placemark's color to reflect occupancy changes, and added placemarks to tag new vacancies. A coding guide is included in the Tracking Changes Over Time section below. Identifying vacant lots may appear simple and straightforward. However, practice reveals that the distinction between occupied and vacant is not necessarily clear.

Identifying Structures and Deciding on Definitions

During the coding process, one will often come upon a questionable image or structure and will be unsure of how to code the lot. For example, the image's resolution may be less than desirable, calling into question whether the blur on the lot is a structure, the imprint/foundation from a previous building, or merely a change in vegetation. Looking for a shadow is perhaps the easiest way to verify the existence of a structure on the lot. If there is no shadow, it is more likely that the apparent structure could be an old building footprint or a slab. Examining shadows will also help identify buildings in construction, i.e. the shadow will reveal that the structure is actually a frame. Before making a final decision researchers should look at other structures around the lot in question. If none of the surrounding structures have a shadow, this could suggest that the sun's placement at the time of the image prevents researchers from using the shadow test. Although the research team did not use a separate placemark for "in construction" lots, creating an additional tag for such lots at least in the most recent image, would make it possible to generate interesting insights into construction trends in the community.

Some structures may also seem unusually small in size, calling into question whether the lot should be marked as occupied. An unusually small structure could, for example, be a shed. Again, looking for a shadow is a useful check. Attention to the roof's material can also provide insights. However, much of these insights depend upon the area. A tin roof could indicate a shed or car port, or, as the research team often found to be the case, a secondary roof to protect a trailer from the hot, Texas sun. As researchers become more accustomed to the form(s) of lot occupation from an aerial perspective, they will naturally start to notice such characteristics. A site visit and /or windshield survey might provide additional, more nuanced information for the researcher/research team.[4]

[4] Some recent Google Earth images also provide a street level view of each lot pulling up photographs video photos taken from cameras on a two sides of vehicle that drives down the street systematically taking shots of each lot/dwelling and tying that to the address and lot sequence.

The previous points call attention to the importance of definitions. Whether or not a given lot is "vacant" depends upon the definition of "occupied" and vice versa. Is a lot occupied when it has a structure on it? What if that structure is a shed? What if the lot is occupied by cars, but has no structure? In light of the previously mentioned concerns about low densities, our research team was interested in determining the number of lots that were not consistently used by community members. The research team initially decided that use requires evidence of a livable structure[5]. However, the team also felt that lots that were not occupied by a livable structure, but were clearly being prepared for use in the near future, should not be considered vacant; the lots would likely soon be put to use, increasing the community's occupancy level. Thus, the team ultimately defined a used or "occupied" lot as a lot that has a livable structure - existing or in construction. Conversely, a "vacant" lot meant the absence of a livable structure – existing or in construction. Under these definitions, lots which appeared to be occupied only by a shed, or by an unusually small structure, were considered vacant, but lots occupied by a frame were considered occupied.

Researchers will need to build and change definitions of "occupied and "vacant" throughout the coding process. Marking questions or uncertainties are an important element in this process. For example, in our case one team member felt uncertain of how to code non-residential lots, such as lots with industrial buildings or lots with numerous cars but no structure. Until the team could meet, the researcher tagged the non-residential lots with the agreed upon question or uncertainty tag (a volcano placemark). After some discussion the team decided that, although the uses were alternative, the non-residential lots were nonetheless being consistently used and, thus contributing to higher occupancy in the colonia. Alternative-use lots were considered occupied in all three images (2002, 2006, and 2010). However, our research team wanted to examine the current relative presence of alternative land uses in and across the study colonias so, in the third image (2010) researchers marked alternative-use lots with a special placemark (a red triangle with an exclamation point). Restated, researchers used the red triangle with an exclamation point placemark to tag alternative lot uses in the most recent image, but these lots were nonetheless considered to be a part of the total occupied lot counts for each colonia. Future research would benefit from examining changes in alternative land use over time, perhaps by creating a series of placemarks, like those utilized to track occupation change in this study, to track non-residential uses in all three images.

Researchers can also benefit by marking **property lines** in the most recent image (2010) using the polygon tool[6] in Google Earth.[7] Clear property lines will assist the researcher in locating vacant lots and will greatly facilitate the following "hard counts" phase. Plat maps can be used to verify property lines.[8] A plat map is a scaled map detailing property divisions on a given piece of land that must be submitted before the area can be developed. In addition, a plat map may

[5] We recognized that "livable" is a very subjective term. The purpose of this definition was to exclude sheds or unusually small structures. However, it is important to note that during windshield surveys we noticed very small structures that appeared to be dwelling units.

[6] For more information on the polygon tool review the Google Earth tutorials provided over the internet, free of charge.

[7] Google Earth Pro, the commercial version of the program, comes with a layer that provides property lines.

[8] Even plat maps may not be completely accurate. Indeed, plat maps are maps of the original subdivisions of the piece of land. Over time the lot sizes and even road locations may change and additional, updated plat maps may not be available.

reveal large tracts of undeveloped land that were originally intended to form part of the colonia. At the researcher or research team's discretion, these undeveloped lots can be included in the total and total vacant lot count described in phase two (below). For example, our calculations for vacancies in one IfHS -- Brookhollow Estates -- include undeveloped lots in the total and vacant lot occupancy counts. However, researchers will want to make sure that they mark the undeveloped lots as developer-owned in order to provide more realistic data about total current vacancies (see Phase Three discussion). In order to see a plat map the researcher must visit the appropriate county tax appraisal office. Copies must be made by the appraisal office for a fee. If a plat map is unavailable the researcher should assume relatively uniform lot sizes.

Tracking Changes Over Time

Table 2.1 details the occupancy combination possibilities and their selected placemarks. There are two ways in which this can be done – either to work systematically and identify vacant lots on each image, altering the color of the placemark to reflect changes before moving on to the next image; or to complete the coding on the first image and then to focus on that individual lot over both of the following images (2006, 2010) in order to determine the appropriate final placemark color. The following paragraphs explain both methods. (A list version of each method is also included in the data collection and analysis guide in the appendix).

In the first method the researcher begins by systematically marking vacant lots in the first image (2002) with a red, with a black square, placemark. Moving to the second image (2006), the researcher checks the previously vacant lots for changes in occupancy. When the lot is occupied in the second image (2006), the researcher changes the red, with a black square, placemark to the temporary vacant-occupied (VO) marker (the grey star placemark). After updating the previously vacant, now occupied, lots, the researcher systematically scans the second image (2006) for new vacant lots and marks them with the temporary occupied-vacant (OV) marker (the grey triangle placemark). In the third image (2010), the researcher checks the previously marked lots (vacant and otherwise) for changes, again, adjusting the placemark as needed (VOO, VOV, OVO, OVV – see satellite image coding guide below). As before, the researcher scans the third image (2010) and marks new vacant lots (OOV) (this time with the magenta placemark). The researcher should then scan the third image (2010) one last time for alternative-uses and mark them appropriately (red triangle with an exclamation point placemark). This last step could be done systematically or piecemeal while marking other lots. However, it is suggested that the researcher conduct a final scan focusing only on alternative uses so as not to miss any lots.

In the second method, the researcher also begins by systematically marking vacant lots in the first image (2002) (red, with a black square, placemark). However, after marking the vacant lots, the researcher reviews changes over both of the following images (2006 and 2010) on a *lot-by-lot basis*. Restated, the researcher focuses on one lot identified as vacant in the first image (2002) and flips through both the second (2006) and third images (2010) to arrive at the final placemark color, skipping the temporary vacant-occupied and occupied vacant placemarks (grey triangle and grey star, respectively). It is still important and necessary to scan the second image (2006) for new vacancies so that the placemarks can be adjusted in the third image (2010) where appropriate (OVO-teal or OVV-green). The researcher also still has to scan the third image (2010) for new vacancies (OOV- magenta), as well as alternative-uses (red triangle with an exclamation point).

Image 1 (2002)	Image 2 (2006)	Image 3 (2010)	Placemarks	
v	v	v	Red with black square	
o	o	o	n/a	
v	v	o	Dark blue with image 2 year (2006) in white letters	
v	o	o	Dark blue with image 3 year (2010) in white letters	
v	o	v	Yellow with a black circle	
o	v	o	Teal	
o	v	v	Green	
o	o	v	Magenta	
o	v	?	Grey Triangle	
v	o	?	Grey Star	

Table 2.1: Satellite Image Coding Guide

Triangulation & Further Data Gathering Through "Windshield" Surveys

In addition to satellite image analysis, the research team completed several windshield surveys during March of 2011. A windshield survey is a method in which researchers visit a given site to collect and record information drawn from observation. In our case researchers drove through several communities and recorded lot-level occupancy information on previously printed maps. Conducted from the ground or street-level perspective, windshield surveys permit more nuanced observation and data collection than satellite image analysis. For example, the aerial view provided by satellite imagery can be used identify whether or not there is a structure on the lot and, to a limited extent, the type of lot use. However, the ground-level perspective found in most windshield analyses enables researchers to collect more extensive and detailed data on a lot's occupancy, use and general condition, among other factors. (See also footnote #4 above on street level photographic views in some communities.) In addition, depending upon the availability of recent images, windshield analyses can provide more up-to-date data than

satellite image analysis as the survey may be conducted at the researcher's or research team's convenience.

The main purpose of windshield surveys for this study was to collect equivalent data that could be used as a check against the number of vacant, combined, and alternative–use lots drawn from analysis of the most recent satellite images. However, the team also took the opportunity to collect more nuanced information during the surveys, such as the presence of unoccupied structures and the presence of structures for rent and/or for sale in the surveyed colonias/IfHSs. Ideally the research team would have visited each of the study communities to conduct a windshield survey. However, windshield surveys can be very time consuming and often require significant financial resources (hotel, transportation, food, etc.). Locating accurate maps of a given area,[9] without which the windshield survey will take much longer, may also pose a significant challenge. Thus, windshield surveys were only conducted in a few communities. The colonias/IfHSs were selected according to feasibility - the windshield surveys were conducted over a brief five day trip - and for variety in community size. Where possible the research team also selected communities with imperfect satellite image information, such as fuzzy images or several lot occupation uncertainties. Ultimately, the windshield surveys were conducted in five colonias located in Hidalgo and Webb counties, see Table 2.2 below.

County	Colonia	Size (Total Lots)
Hidalgo	Hoehen Drive	Small (164)
Hidalgo	La Mesa	Small (167)
Hidalgo	Palm Lake Estates	Small/Medium (411)
Webb	Pueblo Nuevo	Small/Medium (308)
Webb	Rio Bravo	Very Large (1377)

Table 2.2: Windshield Survey Colonias

Table 2.3 compares the vacant, combined, and alternative-use lot counts from the windshield surveys with the data drawn from satellite image analysis. In all of the colonias except Palm Lake the number of vacancies identified from the windshield survey is less than the number of vacancies identified in the most recent satellite image. On average the windshield survey findings identified ten fewer unoccupied lots than satellite image analysis. The disparity between the two counts may be the product of differing analysis dates. The windshield surveys were conducted approximately a year after the most recent satellite image, and it is possible that the difference between the two counts is due to occupancy changes that occurred during the period between the most recent images used for analysis and the windshield surveys. (For the exact dates of the satellite images see the study database.).

Another possible explain for the difference is that occupied lots actually contain unoccupied dwellings or structures that are abandoned (see "Survey + Unoccupied" row in Table 2.3). Unoccupied and/or abandoned structure counts are potentially key data when examining occupancy levels in a given community. Where possible, future research should collect and examine data on unoccupied structures. While Google Earth does provide some street level

[9] The most accurate maps are likely to come from tax appraisal offices, see information on plat maps in the following sections. Researchers might also use maps from Google Maps or another online mapping service, but in our experience these maps may have subdivision errors that complicate the survey process.

images that could be used to identify unoccupied structures, the images are unlikely to provide information that is as clear and current as the data that can be derived from windshield surveys.

In colonias and IfHSs owners will sometimes acquire two adjacent lots and combine into a single double sized lot. Sometimes the division between two lots is maintained; but often the lot's internal party boundary is left open. Table 2.3 also demonstrates that, with the exception of Rio Bravo, the number of combined lots identified in the windshield survey was considerably higher than the number of combined lots identified in the satellite image analysis. As with the vacant lots, the differences between these counts could indicate that more owners have chosen to combine their lots since the date of the most recent satellite image. However, it is more likely that the higher number of lot combinations identified in the windshield surveys is due to researcher error. Indeed, quickly identifying lot divisions and combinations from a moving vehicle proved challenging for our research team. Even when the team got out of the vehicle to walk to a specific area, it was often difficult identify lot combinations. In contrast, Google Earth's aerial perspective and tools, such as the polygon tool for drawing property lines, greatly facilitated lot combination identification. Thus, satellite image analysis appears to be a more useful tool for identifying lot combinations. Combinations can later be checked against the County Appraisal District Data (CAD) to ascertain if a combined lot is owned by the same individual(s) (further discussed below).

		Hoehn Drive	La Mesa	Palm Lake	Pueblo Nuevo	Rio Bravo
Vacant Lots	Satellite	11	39	134	141	126
	Survey	8	5	173	134	173
	Survey + Unoccupied	13	12	180	167	190
Combined Lots	Satellite	0	2	6	8	92
	Survey	2	20	24	12	14
Alternative Use Lots	Satellite	0	0	0	34	96
	Survey	0	9	12	16	25

Table 2.3: Vacant, Combined, and Alternative-Use Lot Count Comparison

The number of alternative-use lots (i.e. non-residential) in the windshield surveys relative to the satellite image analyses varied. While in La Mesa and Palm Lake Estates the surveys identified more alternative-use lots, in Pueblo Nuevo and Rio Bravo the survey counts were lower. The higher number of alternative-uses identified in the satellite images for Pueblo Nuevo and Rio Bravo is interesting. It is possible that alternative-uses have been phased out since the most recent satellites images for these communities. However, it is also possible that the difference between the counts is due to human error, e.g. misidentifying lot divisions and/or uses. Indeed, in theory, the ground-level perspective in the windshield surveys should yield higher results for alternative-use lots because it enables to researcher to identify alternative uses that may be less apparent from an aerial perspective, such as a shop or a restaurant. However, such structures are often residential and work units. Future research would benefit from windshield surveys that both identify alternative-uses and attempt to tease out such live & work structures.

In addition to vacancy, lot combination, and alternative-use data, the research team noted any lots with a multi-family dwelling (apartments) and any lots that were marked for sale or for rent. Table 2.4 provides data from the windshield surveys. Although the sample is limited, the data

collection does provide some interesting insights. Indeed, it is noteworthy that not all of the units in the study communities are owner-occupied and that some land owners have even invested in the construction of multi-family dwellings specifically for non-owners. The presence of clearly marked lots and structures that are for sale is also interesting and is being studied by one team member (Durst) as part of what will become his Master's thesis in 2013.

County	Colonia	Apartment	For Rent	For Sale
Hidalgo	Hoehn Drive	0	0	4
Hidalgo	La Mesa	30	0	1
Hidalgo	Palm Lake Estates	10	1	15
Webb	Pueblo Nuevo	0	2	1
Webb	Rio Bravo	7	7	23

Table 2.4: Apartment, For Rent, and For Sale Windshield Data

Overall, therefore, windshield surveys and triangulation was especially useful to differentiate between occupied and unoccupied residential structures on the ground and to confirm that lots were truly vacant. The windshield surveys also provided estimates of structures/units that appeared to have both residential and work functions, structures for sale, and multi-family units. However, as a means to gather accurate data about combined lots, the Windshield method did not work well. Aerial images, crosschecked if necessary with the data available on tax appraisal websites, prove more reliable.

Phase Two: Generating the "Hard" Counts

For this study, occupancy change was broken down into three time horizons (A, B, C), based on changes occurring in the period between two images. For example, time horizon B refers to the period between image one (2002) and image two (2006); while time horizon C refers to the period between image two (2006) and image three (2010). The first image would normally just serve as the starting or jump off point for the analysis. However, since this study includes data from Ward et al for the year 2000 (2000), we were are able to generate time horizon A data, which refers to changes that occurred between the Ward et al 2000 data and image one (2002). Thus, time horizon A refers to the period from 2000-2002, time horizon B refers to the period from 2002-2006, and time horizon C refers to the period from 2006-2010.

In order to generate data on occupancy change, researchers must enter data into the master database included as a part of this report package. Most of the database is automatically populated. (See the study database, columns I through O, for an example of a populated database). Placemark data, such as the number of green or yellow placemarks in a community, however, has to be entered manually. (Instructions for how to organize and count placemarks can be found under **A Note on Storing Placemarks** in the Data Collection and Analysis Guide.) These data inform the formulas and figures that are automatically populated. (See note about automatically generated figures in the guide.)

Researchers must also count and manually record the total number of lots in each community. Total lot counts can be complicated, especially if the community is large. As previously mentioned drawing property lines with Google Earth's polygon tool can facilitate lot demarcation and counting (see last paragraph of Tracking Change Over Time). In addition, total lot counts can be broken down and temporarily stored in placemarks to avoid miscounting. For example,

the researcher could add a placemark to each street in which to store the street's total lot count, i.e. the total lots to the left of the street plus total lots to the right of the street. The total lot counts in each street placemark could then be summed to generate a total lot count for the entire colonia.

Phase Three – Ownership Searches

In phase three researchers use tax appraisal websites to review ownership information for all lots that are vacant in the third and final image (2010). Researchers review the ownership information in order to identify both formal and informal lot combinations, as well as any vacant lots that may potentially belong to the community's developer. Vacant lots in the most recent image that require ownership searches include lots with the red, with a black square (VVV), magenta (OOV), green (OVV), and yellow, with a black circle (VOV) placemarks. Although the number of combined lots cannot be used to recalculate total occupancy in this study,[10] information about the magnitude of lot combination in various colonias/IfHSs does provide further insight into factors supporting current vacancy levels. In our study we only examined the most recent image for lot combinations. However, if sufficient historical ownership data is available, future research could examine changes in the magnitude of lot combinations over time. Indeed, some tax appraisal websites currently offer information about the last three transactions and title changes for each lot.

Identifying current lot combinations is fairly simple. The name of the lot owner, as well as a myriad of other information such as property IDs and lot and structure values, can be found on the county tax appraisal district websites. Most websites provide a property search and map that can zoom to the lot level. Searching for a street name[11] (under the property address search) will provide links to a number of properties on that street and a link to the map. In order to identify the exact lot to investigate, the researcher will have to count lots in the Google Earth image and locate the same lot on the tax appraisal website's map. For example, the lot in question might be the fourth lot from the west end of the street, on the south side.[12] (Identifying the exact location of a lot in Google Earth is made much easier by drawing property lines, see last paragraph of Tracking Changes Over Time.) In our experience, some website maps only display the property ID, so the researcher may have to verify ownership information by conducting a second search using the property ID identified on the tax appraisal map. (See the Data Collection and Analysis Guide for detailed instructions). Many websites do, however, provide the option to display multiple layers on their maps so that the researcher can see the owner name, among other information.

[10] Recalculating total density would require reviewing property information for every single lot in the colonia. Adjusting only the vacant lot counts for combinations would inflate the total number of occupied lots. Thus, the total number of occupied lots would also have to be adjusted for lot combinations as well, i.e. combined lots where both lots are occupied.

[11] Google Earth should automatically display street names. If the street names do not appear, select the "roads" layer or the map icon and toggle back and forth.

[12] Researchers should work out a system for identifying and describing lot locations, particularly if there are multiple researchers sharing information. Both Google Earth and the tax appraisal maps provide a compass for orientation.

After locating the lot in question and verifying the ownership information (the owner's name), the researcher must check the same information for adjacent lots, i.e. lots sharing a property line with the lot in question. Occasionally, the lots are **formally combined**; a new property line has been drawn around both lots and there is only one property ID. However, not all individuals will choose to combine their lots formally. For example, the owner may not want to go through the trouble of re-separating the lots in case they decide to sell the vacant lot in the future. When two adjacent lots have the same owner, i.e. the property owner's name for both lots is exactly the same or very close,[13] this constitutes an **informal lot combination**. For both formal and informal lot combinations the researcher will place an additional placemark on the vacant lot.[14] While adding these data, it is very important not to remove any of the previous placemarks as they trace a different phenomenon – occupation change over time. As Table 2.5 demonstrates, the yellow house placemark signifies a formal lot combination and the grey bubble placemark signifies an informal combination.

Ownership/Combinations	**Placemarks**	
Developer-Owned Lot	Blue Flag	
Formal Lot Combination	Yellow House	
Informal Lot Combination	Grey Bubble	

Table 2.5: Ownership Satellite Image Coding Guide

Often, a particular name will appear repeatedly in the property searches for vacant lots. This person may be the developer. Site visits and discussions with community organizations and/or residents about the community's history could help verify this information. Text on a plat map may also verify the original developer's name. If a site visit or plat map review is not possible, it is very important that the repeated name in the tax appraisal information is identical, or so similar as to avoid any reasonable doubt. In our experience, many residents have the same last name, often indicating multiple family members in the same community (confirmed in informal

[13] For example, lot A is registered to Joe Hernandez Morales and lot B is registered to Joe. M. Hernandez or if lot A is registered to Jose Miguel Smith and lot B registered to J.M. Smith

[14] For informal combinations the researcher may want to make a note in the placemark with information about combination, e.g. which lot is the vacant lot combined with (location), what are the names and property IDs of both owners, etc. This quick extra step may be useful in later analysis, particularly if the researcher is interested in conducting targeted surveys and/or interviews.

interviews), but not always. It is also important to note that ownership by the developer does not mean that there is not another individual purchasing the land. The developer's name only indicates that the tax appraisal information has not been changed, likely because the buyer has not yet completed payments. Therefore, we suggest conservative judgment about potential developers as well as lot combinations. ***When the researcher is quite sure that the vacant lot belongs to the developer she or he will add a blue flag placemark to the lot (see Table 2.5). Totals for each of the previously mentioned placemarks (yellow house, grey bubble, and blue flag) will need to be entered into the master database (discussed later).*** (Again, we advise creating separate folders to ease tallying. See **A Note on Storing Placemarks** in the guide).

Alternative Sources for Ownership Information

Not all county websites have property searches linked to maps. Indeed, some counties still use the traditional or paper based registries. Traditional registries can also be used to verify ownership information, although the process is more time consuming and likely requires travel to the county tax appraisal office. Indeed, our research team used paper-based registries to conduct analysis for Mike's in Starr County. Access to information will vary depending upon the resources of county offices and employees. Some county offices will be more helpful than others and some records may be more organized than others.

Other counties may have Geographic Information Systems (GIS) files. With the appropriate files, researchers can easily use GIS to display the owner names, etc. directly on the map, eliminating the extra step of looking up property ID numbers to verify and compare the owner names. While GIS is a very advanced and extremely useful program, it is also expensive ($1,500).[15] Access to individual files may also incur a cost. In Texas, several counties are currently involved in a project to create and collect GIS files. Ultimately, these files will be used to create public property search maps like those mentioned above. In the interim, our research team found that many counties had the GIS files available. University access to GIS enabled our research team to utilize these files wherever possible.

The Excel Workbooks

In addition to providing a guide for applying the methodology created for the study, this report package includes two Excel Workbooks: the study workbook and a master workbook. The **Lot Occupation Study Workbook** contains the database (first sheet) and the separate calculations that inform the findings and analysis in our study. The study workbook is also intended to serve as an example of a populated database for future researchers to consult. The **Master Template Workbook** contains a database template that is intended to serve as a frame into which future researchers may enter their own data and conduct their own analysis. The master database has been adjusted to include only information drawn from satellite image analysis; all of the columns and calculations related to the Ward et al 2000 database have been removed or changed. The following paragraphs further describe the template database.

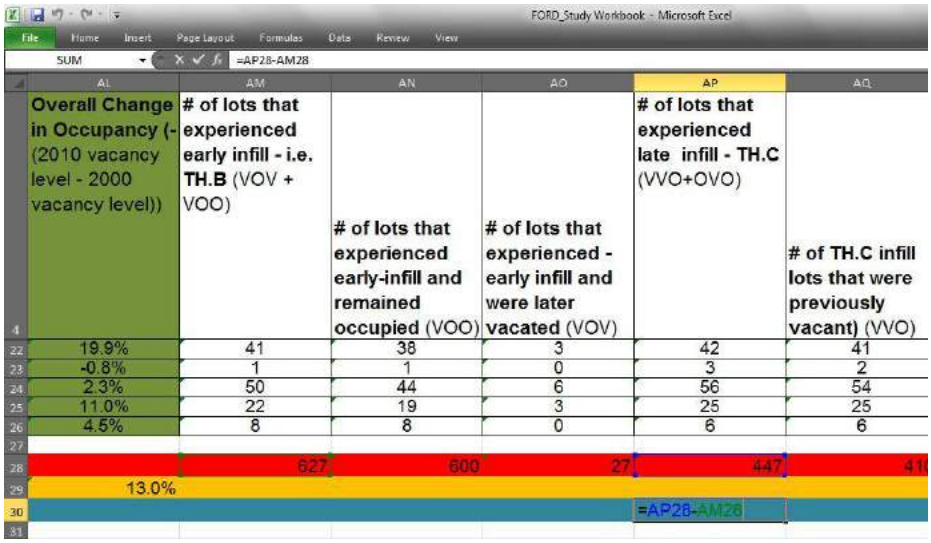
The template consists of ten sections. Only the first two sections - General Information and Placemarks - require data entry. Information such as the colonia name, the county where it is located, the total number of lots and the exact image dates used for analysis is entered into the General Information Section. Similarly, all of the tallied placemark data from Google Earth

[15] http://store.esri.com/esri/showdetl.cfm?SID=2&Product_ID=29&Category_ID=121

should be entered into the Placemarks section. The remaining eight sections of the master database are automatically sourced to the entered data and/or calculated through established formulas. Sections three through five (Vacant Lot Counts, Occupied Counts, and Vacancy Levels) generate hard counts and percentages that describe occupancy in each of the images. The sixth section – Occupancy Changes – uses vacancy level data from each image to generate time horizon data. The following two sections – sections (seven and eight) on Infill and Outflow – generate numbers and percentages related to churn for time horizons B and C. Section nine - Current Vacancies/Ownership – generates percentage calculations based on previously entered ownership data, and the final section calculates the presence of alternative-use lots. ***The formulas for calculating the automatically generated data are included in the section and/or title columns***.

The master template database also has three additional rows located below the data sections that provide aggregate numbers based on the individual community data that has been entered or generated. Located in row 28, the **Total #s** row sums data in the columns where appropriate. The **Total %s** row, located in row 29, uses the totals in the previous row to generate aggregate percentages. Finally the **Difference** row, located in row 30, calculates the difference between two given numbers, such as the difference between the total number of vacant lots in 2002 and the total number of vacant lots in 2006. Not all of the values generated in the Total %s and Difference rows are based on adjacent columns, or even columns in the same section. Therefore, ***it is important to check the cells that the formulas reference***. One can check the formula in a given cell by double clicking the cell. As Figure 2.1 demonstrates, the number in the cell will be replaced by its formula. In this case 180 is replaced by AI28-AF28 and the sourced cells are highlighted in different colors for easy identification.

Figure 2.1 : Formula Reveal in Excel



Analysis in Excel

The master database generates and organizes most of the data needed for analysis, particularly in the case of aggregate data. However, the large amount of data may become confusing or

overwhelming during analysis. Excel's **Hide** and **Freeze** options (discussed further in the Data Collection and Analysis guide) can be used to adjust the amount of data displayed on the screen. Excel also has a **Custom Sort** option in the **Sort and Filter Tool** (also discussed in the guide) that is invaluable for comparing individual communities. The Sort and Filter tool permits the researcher to organize multiple columns of data according to the order of a single column. For example, the tool can be used to reorder rows in the County, Colonia, and Overall Occupancy Change columns from the least to highest numbers in the Overall Occupancy Change column. Table 2.6 provides an example of data before and after using the custom sort option. As the table demonstrates, not only is the Overall Change column reordered, but also the relevant information in the County and Colonias columns is reorganized accordingly. ***These tools may be used in the master database worksheet. However, we recommend selecting and copying the data that you wish to analyze into a new worksheet to avoid accidental changes to the formulas or entered data.***

Before			**After**		
County	Colonia	Overall Change in Occupancy	County	Colonia	Overall Change in Occupancy
Bastrop	Stony Point	9%	Guadalupe	Rancho Vista	-1%
Cameron	Arroyo Colorado	2%	Cameron	Arroyo Colorado	2%
Cameron	Valle Escondido	8%	Hidalgo	Hoehn Drive	2%
Coryell	Willow Springs	5%	Hays	Hillside Terrace	4%
El Paso	Vista del Este	8%	Coryell	Willow Springs	5%
El Paso	Sparks	10%	Guadalupe	Brookhollow	6%
Guadalupe	Rancho Vista	-1%	Webb	Tanquecitos	6%
Guadalupe	Brookhollow	6%	El Paso	Vista del Este	8%
Hays	Hillside Terrace	4%	Cameron	Valle Escondido	8%
Hidalgo	Hoehn Drive	2%	Bastrop	Stony Point	9%
Hidalgo	Palm Lake	23%	El Paso	Sparks	10%
Webb	Tanquecitos	6%	Webb	Pueblo Nuevo	12%
Webb	Pueblo Nuevo	12%	Hidalgo	Palm Lake	23%

Table 2.6: Excel Custom Sort, Before and After

Correlations

While the majority of analysis in this study relies on the numbers generated in the database, we found Excel's correlation coefficient analysis tool useful for examining potential factors related to occupancy changes in the individual communities. Excel provides a data analysis toolkit add-in that enables researchers to conduct a correlation analysis (among other options.) (See the Data Collection and Analysis Guide for detailed instructions on acquiring the data analysis add-in and running the correlation.) ***Again, we suggest moving the data from your main database worksheet to a new sheet or a new workbook, by copying and pasting the data you would like to test.***

The correlation tool analyses the behavioral relationship between two variables and generates a number that indicates whether the two variables are relationally linked. Stated differently, the correlation tests the strength of a linear relationship between two number values. The

correlation coefficient is always a number between -1.0 and 1.0. The closer the correlation number is to 1.0 (in either direction), the stronger the linear relationship between the two variables, i.e. the stronger the behavioral relationship between X and Y. For the purposes of this study, a correlation of 0.8 or more (in either direction) indicates a strong behavioral relationship between the variables.

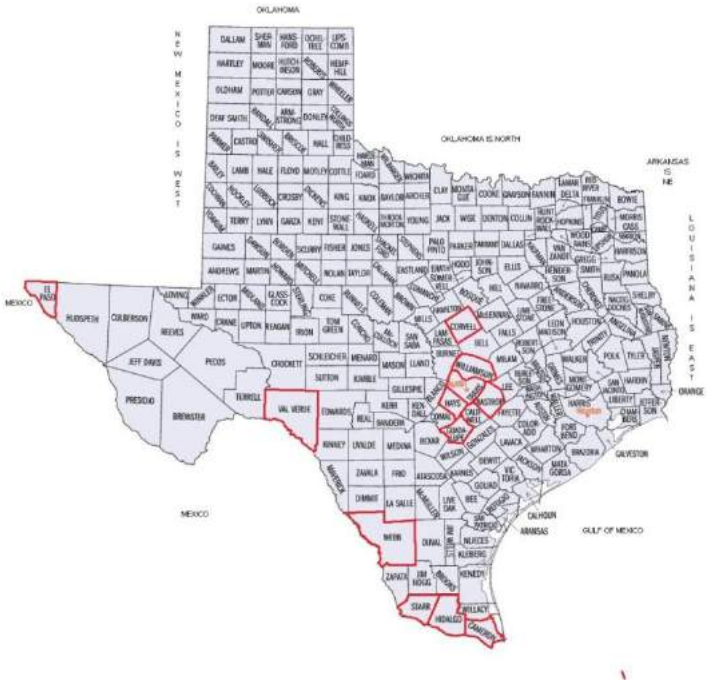
The correlation number also tells us the directionality of the behavioral relationship. For example, the closer the coefficient is to 1.0, the stronger the positive linear relationship between X and Y, i.e. when X increased, Y also increased. Conversely, the closer the coefficient is to -1.0, the stronger the negative linear relationship, i.e. when X increased, Y decreased. ***It is important to note that the correlation number only describes behavior, NOT causation. For example, even if there is a strong positive linear relationship between X and Y (1.0), this does not mean that X causes Y. Rather the correlation number indicates that X and Y behaved in the same way*.** Variables with strong correlations (in either direction) are useful building blocks with which to form a much more complex and explanatory regression model. However, such a model is outside the scope of this study.

The Case Study Communities

Since most of case study colonias/IfHSs in this report were drawn from the Ward et al (2000) study, it is important to review their methodology for selecting study colonias/IfHSs. To start, each of the ten counties from which the authors chose case studies were identified by the Texas Water Development Board – the agency charged with statewide water planning and assistance in Texas - as having a high incidence of colonias (p.38). Individual colonias from those counties were selected on the basis of size and location, as well as history and level of service provisions, in order to a varied and representative sample. Very small colonias were, however, excluded because of concerns over a sufficient number of cases to support inter-colonia comparisons (2000: 38-39). (Colonia size categories for the Ward et al study can be found on page 20 of their report.)

Our own study examines 22 colonias/IfHSs, drawn from eleven different counties in Texas. The counties – Bastrop, Caldwell, Cameron, Coryell, El Paso, Hidalgo, Travis, Val Verde, Webb, and Williamson - are highlighted in Figure 2.2. As the figure demonstrates, six counties are located along the Texas border with Mexico, and five study counties are located in central Texas. As previously mentioned, 20 of the 22 study colonias in this report were the same communities examined by Ward et al (2000), permitting use and extension of their initial findings on vacancy levels. The two additional study communities, both located in Guadalupe County, were chosen subsequent to a major recent survey directed by the PI, *Housing Conditions, Sustainability and Self Help in Rancho Vista and Redwood Informal Homestead Subdivisions in Central Texas* (2010)(see also www.lahn.utexas.org & click on Texas Housing Studies).

Figure 2.2 Map of the Study Counties



The total lot counts from the Ward et al (2000) study did not match the total lot counts generated from the satellite image analysis used in this report. Most of the total lot counts from the satellite image analysis differed from Ward et al dataset by only +/- ten lots. However, in a few communities the difference between the total lots counts was sizable. For example, the satellite image analysis counts for Val Verde had an additional 562 lots not included in the original study's count. Similarly, the satellite image count for Palm Lake had an additional 315 lots. Particularly problematic, the satellite image count for Deerfield Park was 141 fewer lots than the original study's total lot count (259 versus 400, respectively). The larger discrepancies in the total lots counts result from the Ward et al (2000) use of plat maps to inform total lots counts and to record study findings. For example, in the case of Deerfield Park, it appears that the plat map recorded four planned sections of the colonia, while our analysis was based on only the two built out sections. In the cases of Palm Lake and Val Verde, an additional plat could have been submitted after the initial plat used to derive the Ward et al counts, resulting in more development than originally recorded. Due to the discrepancies in total lot counts, an adjuster, based on the difference between the Ward et al counts our own, was used to make the original study data equivalent and thus comparable to the satellite image analysis data. Table 2.7 provides the satellite image generated total lot counts as well as the 2000 original lot counts from the Ward et al study and the adjuster (see also column T in the study database). ***For the purposes of consistency, unless explicitly stated otherwise, numbers and calculations are based on the satellite image or adjusted original study counts.***

Table 2.7 also organizes the study colonias into six groups on the basis of colonia size. These are:

- Very Small - less than 100 lots
- Small - between 100 and 299 lots
- Small/Medium - between 300 and 549 lots
- Medium - between 550 and 799 lots
- Large - between 800 to 1199 lots
- Extra-large - 1200+ lots

As the table demonstrates, the nearly 3/4 of study colonias fall into the small and small/medium ranges (16/22 colonias or 8 in each category). There are also several colonias which fall into the very large range. The representation for very small and for medium size colonias is, however, less, and none of the study colonias fall within the large colonia range. Future research would benefit from including more case studies of very small, medium, and large size colonias.

	County	Colonia	Total Lots	Total Lots (2000)	2000 Adjuster
Very Small (<100 Lots)	Cameron	Valle Escondido	86	86	0
Small (100-299 Lots)	Webb	Larga Vista	130	136	-6
	Coryell	Willow Springs	152	148	4
	Hidalgo	Hoehn Drive	164	164	0
	Hidalgo	La Mesa	167	166	1
	Travis/Williamson	Northridge Acres	189	203	-14
	Guadalupe	Brookhollow	197	n/a	n/a
	Webb	Tanquecitos	201	229	-28
	El Paso	Deerfield Park	259	400	-141
Small/Medium (300-549 lots)	Starr	Mike's	306	320	-14
	Webb	Pueblo Nuevo	308	300	8
	Hays	Hillside Terrace	339	356	-17
	Guadalupe	Rancho Vista	340	n/a	n/a
	El Paso	Vista del Este	364	365	-1
	Cameron	Arroyo Colorado	375	410	-35
	Bastrop	Stony Point	389	397	-8
	Hidalgo	Palm Lake	411	96	315
Medium (550-799 lots)	Val Verde	Cienegas	763	763	0
Very Large (1200+ Lots)	Val Verde	Val Verde	1371	809	562
	Webb	Rio Bravo	1377	1447	-70
	El Paso	Sparks	1589	1452	137
	Cameron	Cameron Park	1608	1603	5

Table 2.7 Colonia Total Lot Counts and Size Ranking with Original Study Counts and Adjuster

Community Descriptions

The following paragraphs briefly describe the study colonias and IfHSs, namely their location, and how occupancy has changed over the past decade. Some of the original plat maps for the communities can be found in the Ward et al (2000) study. In addition, the Office of the Attorney General of Texas provides a database and localizing maps for many of the colonias examined in this study (see http://maps.oag.state.tx.us/colgeog/).

Bastrop County

- **Stony Point** is located 17 miles southeast of the city of Austin, near the old Austin Bergstrom Air Force Base. Stony Point's overall occupancy increased by 5.7% over the past decade. In 2000, Stony Point's vacancy level was 16.5%, or 64/389, lots and by 2010 the vacancy level had decreased to 10.8%, or 42/389 lots.

Cameron County (border)

- **Arroyo Colorado Estates** is located off of Highway 1846, less than eight miles east of the city of Harlingen. First plated in 1962, Arroyo Colorado Estates is among the oldest colonias in the study. Over the past decade occupancy increase by 8.3%, decreasing from 33.1% (124/375) vacancy in 2000, to 24.8% (93/375) vacancy in 2010
- **Cameron Park –** With 1,608 lots, Cameron Park is the largest study colonia and, first plated in 1961, it is also among the oldest study colonias. The colonia has been officially incorporated into the city of Brownsville and is located approximately seven miles north of the city center. Over the past decade occupancy increased by 12%. The current (2010) vacancy level in Cameron Park is 10.3% (165/1608). In 2000, Cameron Park's vacancy level was 22.3% (358/1608).
- **Valle Escondido** is located just over nine miles southeast of the city of Brownsville. It is the smallest of the study colonias and has experienced the greatest overall change in occupancy of the three colonias in Cameron County. Originally plated in 1984, Valle Escondido's vacancy level in 2000 was 24.4% (21/86). By 2010 the colonia's vacancy level had reduced to 8.1% (7/86), a 16.3% overall increase in occupancy.

Coryell County

- **Willow Springs (1&2)** is located along farm to market 116 just south the city of Copperas Cove. Originally plated in 1994, Willow Springs experienced one of the highest overall occupancy changes of the study communities. In 2000 the Willow Springs' vacancy level was 34.9% (53/152). Over the following decade occupancy in the community increased 15.8% (26/152), resulting in 19.1% vacancy rate in 2010.

El Paso County (border)

- **Deerfield Park (1 & 2)** is located just south of highway 180, nearly 21 miles east of the El Paso city center. Unfortunately, the total lot counts in the Ward et al study were too dissimilar from our own to generate reliable number on occupancy change over the past decade. However, since 2002 occupancy in Deerfield Park increase by 8.1%, from 22.4% (58/249) vacancy in 2002 to 14.3% (37/259) vacancy in 2010.
- **Sparks** is located between Socorro and Horizon City, approximately 18 miles south of El Paso. Spark is the second largest study colonia with 1,589 total lots and the oldest study colonia having been first platted in 1958. In terms of the total number vacant lots, Spark's has experienced the highest decrease in the number of vacant lots (-316), equating to a 20% overall increase in density. Spark's vacancy level in 2000 was 48% (463/1589) and by 2010 the vacancy level was 28.1% (447/1589).
- **Vista Del Este** is also located off highway 180, just before Deerfield Park (20 miles east of El Paso). Vista del Este's 2.7% overall occupancy change during the past decade is the lowest overall change of the study colonias. However, the colonia began and has remained among the least vacant colonias in the group, decreasing from 11.5% (425/364) vacancy in 2000 to 8.8% (32/364) vacancy in 2010.

Guadalupe County

- **Rancho Vista** is located approximately five miles southeast of the city of San Marcos. Based on the period from 2002-2010, Rancho vista has experienced minimal occupancy change over the past decade (1.2%). However, Rancho Vista was the least vacant of the study colonias in 2010 (5.3% (18/340)).
- **Brookhollow Estates** is located near to Rancho Vista off of farm to market road 621, approximately six and a half miles from San Marcos' city center. During the period from 2002-2010, Brookhollow's occupancy increased 5.6%. Because a large portion of the

colonia remained undeveloped, Brookhollow's vacancy level remained very high in 2010 (44.7% (88/197).

Hays County

- **Hillside Terrace** is located 13 miles south of Austin, very near to the city of Buda. Occupancy in colonia increased 7.7% from its 29.8% (101/339) vacancy level in 2000. Hillside Terrace's 2010 vacancy level was 22.1% (75/339).

Hidalgo County (border)

- **Hoehn Drive** is located north of McAllen and Edinburg, off of interstate 281 on west Monte Christo Street. With a vacancy level 15.9% (26/164), Hoehn drive was among the more occupied colonias in 2000. Although the colonia's overall occupancy change was somewhat low (9.1%), in 2010 Hoehn drive was among the least vacant study colonia. The colonia's vacancy level was 6.7% (11/164) in 2010.
- **La Mesa** located six miles north of the town of Mercedes off of the mile 11 road. La Mesa's overall occupancy increased just 6% over past decade. In 2000, 29.3% (49/167) of the lots were vacant. In 2010, 23.4% of the lots were vacant (39/167)
- **Palm Lake 1-4** is located in southern Hidalgo County just north of the town on Alton on Main Avenue and Stewart Road. With 84.9% vacancy (349/411), Palm Lake Estates was the most vacant colonia in 2000. However, over the past decade Palm Lake has experienced the greatest overall change in occupancy. Occupancy in the colonia increased by 52.3%, or 215 lots. The 2010 vacancy level was 32.6% (134/411).

Starr County (border)

- **Mike's** is located east of Rio Grande City and northwest of Sullivan city, off of interstate 183. With a starting vacancy level of 35% (107/306) in 2000, and ending vacancy of 12.7% (39/306), Mike's experienced the third highest overall change in occupancy, 22.2%, or 68 fewer vacant lots.

Travis/Williamson County

- **Northridge Acres** is located just south of Round Rock and north of Austin and spans the Travis Williamson county lines. Northridge Acres was the second most occupied study community in 2000 with a vacancy level of 10.1% (19/189). Over the past decade, occupancy in Northridge Acres decreased by 18%. In 2010, Northridge Acres had 34 more vacancies than it did in 2000, leading to a vacancy level of 28% (53/189).

Val Verde (border)

- **Ciengas Terrace** is located just over four miles southwest of the city of Del Rio, in between the city and the Rio Grande River. In 2000, Ciengas Terrace had one of the highest vacancy rates, 53.2% (406/763). Over the past decade occupancy in Cienegas Terrace increased by 19.9% (152 lots). Despite this large overall occupancy change, Cienegas Terrace remains among the most vacant colonias in 2010 with a vacancy level of 33.3% (254/763).
- **Val Verde** is located four and a half miles east of the city of Del Rio and approximately the same distance from the Laughlin Air force Base. Val Verde is among the largest colonias and, in 2000, was the second most vacant colonia with a vacancy level of 59.2% (811/1371). Val Verde experienced the second highest occupancy change during the past decade and the highest decrease in terms of the total number of vacant lots. Vacancy in Val Verde decreased by 32.5% (-446 vacant lots) from its 2000 vacancy level to its current (2010) vacancy (26.6% (365/1371)).

Webb County (border)

- **Larga Vista** has been officially incorporated into the city of Laredo and is located east of the city along highway 359. Larga Vista experienced the least change in occupancy over the past decade and that change was negative (-0.8%). However, Larga Vista was the least vacant (or most occupied) colonia in the study group in 2000 (vacancy level 9.2% 12/130) and, thus, it remains among the least vacant of the study colonias in 2010 (2010 vacancy level was 10% (13/130).
- **Pueblo Nuevo** is located 14 miles east of the city of Laredo, off of highway 359. Pueblo Nuevo was among the most vacant of the study colonias in 2000 (56.8% vacant 175/308) and, due to its relatively minimal change in vacancy (11%), it remains among the least occupied study colonias. Pueblo Nuevo's vacancy level in 2010 was 45.8% (141/1308).
- **Tanquecitos/Los Altos** is located just over nine miles east of Laredo between Larga Vista and Pueblo Nuevo on highway 359. In 2000, Tanquecitos' vacancy level was 23.9% (48/201). In 2010, the colonia's vacancy level was 19.4% (39/201), an increase in overall vacancy of 4.5%.
- **Rio Bravo I, II, III** is a self-incorporated city located 14 miles south of downtown Laredo, off of highway 83. Rio Bravo experienced the least positive occupancy change over the past decade (2.3% or 23 fewer vacancies). However, given its already low vacant level in 2000 (14.9% (205/1337), the colonia remains among the most occupied study colonias (12.6% (173/1377).

Part 3. Study Findings

The findings in this report are based primarily on data from the satellite image analysis. However, as previously mentioned the vacant and total lot count from the Ward et al (2000) absentee ownership study are also used. Since total lots counts in the Ward et al study (based on plat maps) differed from the total lot counts in the satellite image analysis, numbers from the Ward et al study were adjusted to be equivalent to our own. Unfortunately, the data for Deerfield Park is only available from 2002-2010 since the adjustment generated negative numbers.[16] Data for the two additional informal homestead subdivisions not examined in the original study – Rancho Vista and Brookhollow – is also limited to the 2002-2010 time periods, as no satellite images from 2000 were available for either development.

The findings section is divided into three parts. Conducted from several different, and increasingly nuanced, standpoints, we first analyze occupation changes using primarily aggregate data. After discussing the overall changes in the aggregate vacancy level from 2000-2010, we break down occupancy changes into three time horizons (A, B, C) each of which is reexamined. Finally, the analysis explores the influence of churn – the combined processes of infill and outflow – on aggregate occupancy changes during the latter two time horizons. The second part of the analysis briefly explores variation among the individual communities, specifically the trends and possible explanations for the communities' individual overall changes in occupancy, with variables from the study and beyond. Third, we analyze tax appraisal data in order to examine who are the owners of current (2010) lot vacancies and touch briefly on non-residential or alternative lot land uses in the study colonias/IfHSs.

[16] The lot counts for Deerfield in the Ward et al study are based on plat maps – which include four sections – while out counts are based on the developed areas – Deerfield sections one and two only.

General Occupancy Change

Occupation levels in the study colonias and IfHSs changed notably over the past decade. Indeed, while in 2000, 33.7%, or 1/3, of all lots were vacant, by 2010, this had declined to only 20.7%, or one-in-five. Thus, at least in these 22 settlements, overall occupancy increased by 13% between from 2000-2010. In addition, occupancy changes over the past decade resulted in less variation in the recorded vacancy levels of individual communities. According to the Ward et al (2000) study data, only ½ of all study colonias/IfHSs (10/20) had vacancy levels below 30% in the year 2000. The satellite image analysis data indicates that by 2010 most colonias/IfHSs (82% or 18/22) had vacancy levels below 30%. When the two additional subdivisions not included in the original study (Rancho Vista and Brookhollow) are removed, the number of communities with vacancy levels below 30% increases still further to 95% (19/20).[17] Indeed, all but one of the original study areas had a vacancy level at or below 30% in 2010.[18] Thus, in general, over the past decade, the study colonias/IfHSs became more occupied or, stated, differently, vacancy in the study colonias/IfHSs decreased.

The detailed satellite image analysis employed in this study enables us to breakdown this overall change in vacancy/occupancy over the past decade into three time horizons. As Table 3.1 demonstrates, each time horizon spans the period between two images, a starting image and an ending image. Time horizon data is thus based on the occupancy changes that occurred between the two images. For example, time horizon B data is based on occupancy changes that occurred between the 2002 images and the 2006 images, such as a lot that was vacant in a 2002 image becoming occupied in a 2006 image.

Time Horizon	Starting Image Date	Ending Image Date	Period for Time Horizon
A	2000*	2002	2000-2002
B	2002	2006	2002-2006
C	2006	2010	2006-2010

*2000 data was drawn from the Ward et al (2000) study, rather than a satellite image

Table 3.1: Time Horizon Image Dates and Periods

Examining data from these periods it is clear that while the overall occupancy change is positive in all three time horizons, the rate of occupancy change varied. Table 4.2 provides comparative information on the change in the total number of vacant lots and the overall change in occupancy (*the difference between the vacancy levels in the starting and ending images)* for each time horizon. As the table demonstrates, with each new time horizon the number of vacant lots filled becomes smaller as does the percentage change in occupancy between the starting and ending images for each period. On average, however, the number of vacancies decreased by 480 lots with each new time horizon, leading to a 4.3% increase in occupancy per period.

[17] Brookhollow's 2010 vacancy level remains high (44.7%) due to the inclusion of undeveloped tracts, and Rancho Vista's vacancy level is the lowest of the study group (5.3%).

18 Palm Lake and Ciengas Terrace each had vacancy levels of 33% in 2000. The "outlier in 2010 was Pueblo Nuevo in Webb County – large one acre plus sites furthest out on Highway 359.

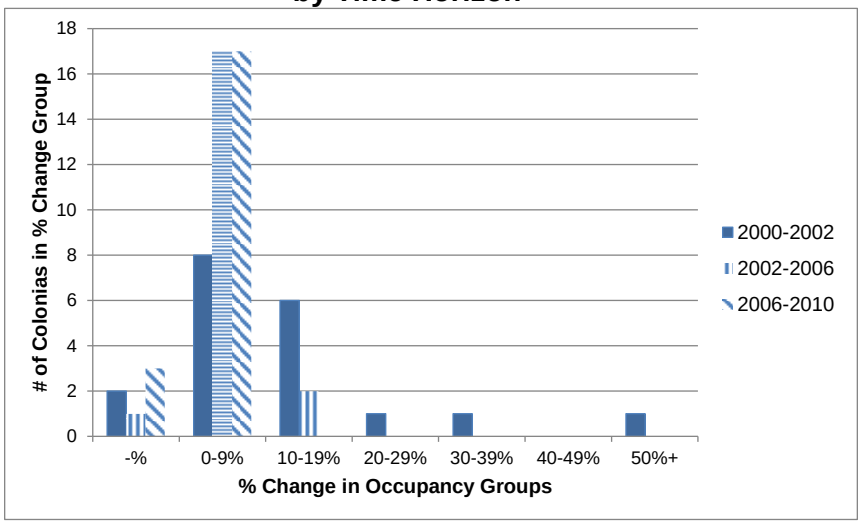
Time Horizon	Change in the # of Vacant Lots (Total # of vacant lots in starting - Total # of vacant lots in ending image)	Occupancy Change (Difference between total vacancy level in starting images and total vacany in ending images)
A (2000-2002)	-571	5.2%
B (2002-2006)	-524	4.7%
C (2006-2010)	-344	3.1%
Average	**-480**	**4.3%**

Table 3.2: Time Horizon Vacant Lot and Overall Occupancy Change Comparisons

At the aggregate level, variations in occupancy changes across between the time horizons was modest, although at the individual community level one does observe more notable variation. However, rather than display these occupancy changes for each individual colonia/IfHS, Figure 3.1 facilitates comparisons by organizing the communities into occupancy change groups for each time horizon (displayed along the horizontal or X axis). (For exact figures see the Excel study database.) The number of colonias/IfHSs that fall within a given occupancy group is measured along the vertical or Y axis. Thus, for example, the chart demonstrates that in time horizon A eight colonias/IfHSs experienced an occupancy change between 0% and 9%, and a further six experienced an occupancy change between 10% and 19%.

Figure 3.1 can also be used to examine changes in the spread or distribution of occupancy changes for each time horizon. The chart demonstrates that during time horizon A, occupancy changes ranged from negative numbers to an over 50% increase in occupancy. However, the range or distribution of occupation change in each of the following time horizons – time horizons B and C - is considerably smaller. Occupancy changes in time horizon B ranged from negative numbers to 19% and occupancy changes in time horizon C ranged from negative numbers to only 9%. Thus, variation in the magnitude of occupancy change decreased with each sequential time horizon, suggesting a possible stabilization in the rate of occupancy change in the study colonias and IfHSs. This possible stabilization or leveling off is also supported by the fact that in the overwhelming majority of study communities (17/20) occupancy increased by only 0-9% during the last two time horizons.

Figure 3.1: Occupancy Change Groups Representation and Distribution by Time Horizon



* Data from Deerfield Park only available for time horizons B and C;
Rancho Vista and Brookhollow not included

Although not displayed in Figure 3.1, a similar stabilization occurred in the negative occupancy changes. While in time horizon A negative occupancy change ranged from -0.8% to -18%, in the later periods negative changes varied only minimally, between -0.8% and -1.2%. (Note that Figure 3.1 does not include information for Rancho Vista and Brookhollow. For exact figures see the study Excel database). Occupancy increases in Rancho Vista and Brookhollow during time horizons B and C fit within the most common percentage change group mentioned previously (0-9%, for exact figures see the study database).

"Churn" In and Out Movements

Lot and property turnover often indicate how a market is working and the extent to which people exercise mobility, buying and selling. Our studies elsewhere (see Report #2 and Ward et al 2003) suggest that because formal financing is rarely available in colonias and IfHSs, and lot sales are dependent upon informal or seller financing, it is often difficult for owners to sell on their lots, especially when the lot also carries a dwelling unit that may be relatively expensive. Hence while vacant lots may still be relatively affordable, higher value built-on lots may be difficult to sell. Thus we might expect that a market with many lot vacancies might attract considerable inflow - as appears to have been the case in the study settlements. Our hypothesis was also that relatively few lots would be vacated. Indeed, when we began the study we assumed that we would find minimum "churn" and that the increase would be linear as lot vacancies reduced.

However, we became aware that there was also an outflow of population: lots that were formerly occupied were sometimes being vacated. The study methodology allows researchers to examine these changes or "churn" which comprises two basic processes: *infill, or* the occupation of vacant lots; and *outflow,* being *the* vacating or exit from previously occupied lots. By breaking down overall occupancy change into these two processes, churn analysis can provide additional information about how housing markets in the study communities have been functioning over the past decade. For example, a given housing market may have demonstrated only minimal net overall growth over the past five years, suggesting that the area grew as a result of slight increases in occupation. However, an analysis of churn may reveal that the apparently slow market growth is actually the result of dynamic movements as residents move in and out of the area. Detailed tracking of lot level changes in our method also allows us to analyze two lot turnover sub-processes: *Re-Infill* – the occupation of lots that experienced outflow during the previous time horizon - and *Re-Outflow* – the vacating of lots that experienced infill during the previous time horizon.

Table 3.3. uses data from time horizon B to demonstrate how infill and outflow has shaped total occupancy changes in the study colonias and IfHSs. Comparing the number of infill lots (lots that have become occupied in the period between the two snapshots) with the number of outflow lots (those vacated) should yield the new total number of vacant lots found in the second image (2006). In the example below, the total vacancies decreased by 524 lots (=627 infill minus 103 outflow). The percentage equivalent, shown in the far right column, is drawn from the previously mentioned figures. Referring back to Table 3.2 one can see that data on overall change derived from churn calculations matches the aggregate data initially used to calculate the overall change (i.e. a 4.7% increase in occupancy levels but reflecting, also an outflow of 103 cases).

Time Horizon B		
	# of Vacant Lots	Vacancy Level (vacant lots / total lots)
Total Vacant Lots 2002	3162	28.5% (3162/11085)
(- Infill)	*-627*	
(+ Outflow)	*+103*	
Total Vacant Lots 2006	2638	23.8% (2638/11085)
Time Horizon Change	**-524 lots**	**4.7% decrease in vacancy**

Table 3.3: Infill's and Outflow's Relationship to Overall Change in Time Horizon B (2002-2006)

Churn analysis was only possible between time horizons B and C (the two satellite images) since time horizon A's data is based on the combination of study data drawn from Ward et al (2000) and detailed analysis of the 2002 satellite images.[19] As a result, churn analysis begins in 2002, the start of time horizon B. In addition, tracking Re-Infill and Re-Outflow requires at least three images and since infill/outflow data is only available from time horizon B (i.e. from 2002) Re-Infill/Re-Outflow analysis could only be conducted for time horizon C.

Table 3.4 provides a more detailed breakdown of occupancy changes during time horizons B and C. Infill and outflow are broken down into early (time horizon B) and late (time horizon C) periods. The data reveals that **both** infill and outflow occurred in the study colonias and IfHSs. The demonstrates that infill played a more prominent role than outflow in both time horizons, i.e. in each of the time horizons the number of infill lots was greater than the number of outflow lots, indicating positive increases over time. The earlier analysis also noted that the overall occupancy change in time horizon C was less than in time horizon B. The churn data in the table also reflects this difference. Early infill – or infill that occurred during time horizon B- was greater both in total number and relative percentage of available vacant lots; 180 fewer lots were filled during time horizon C than during time horizon B (627 early infill lots – 447 late infill lots). Since the number of outflow lots in time horizon C is identical to the previous time horizon (103 lots experienced outflow in both periods), we can see the lesser infill during period three resulted from the slightly lower take up of lot occupancies in time horizon C.

The table also reflects another element of churn: namely that some lots are re-vacated while others that were vacated become reoccupied. We were especially interested in these processes since we wanted to get a sense of how the housing market crisis of 2008 might have shaped lot occupancy and lot vacation (Re-Infill and Re-Outflow processes). In general, in time horizon B almost all (95.7%) of infilled lots remained occupied, but a significant proportion (6.4%) of all occupied lots saw an outflow or exit during the same period. As Table 3.4 demonstrates, 27 of the lots that experienced early infill did not stay occupied, i.e. they experienced Re-Outflow. Stated differently, while 73.8% of the lots that experienced late outflow in time horizon C were lots that had been occupied since 2002, 26.2%, or 27 lots, were

[19] Google Earth images for 2000 were often unavailable. Indeed, in most colonias available images jumped from 1995 to 2002. We also could have attempted to use the coded plat maps generated in the Ward and Carew study to adjust our placemarks in the 2002 images, thus accounting for specific lot changes from 2000-2002. However, the total lot counts in Ward and Carew differed from our own (Ward and Carew's numbers were adjusted to match our own) and, given the time requirements for developing the methodology and applying it to 22 colonias over three time horizons, the research team decided not to take this step.

the result of Re-Outflow of the lots that had only recently been infilled or occupied in 2006. This may have been the result of developers "flipping" lots to buyers who had fallen behind in their payments, or repossessions by sellers, or people walking away (abandoning) their homes because they couldn't afford to remain there and could not find a buyer.[20]

In addition, 37 of the early outflow lots did not remain vacant, i.e. experienced ReInfill. As the table demonstrates, although 91.7% of the late infill lots (time horizon C) were previously vacant lots (or lots that were vacant in 2002), 8.3%, or 37 lots, resulted from Re-Infill or occupation of the newly vacated lots.

Early Infill (Time Horizon B) ((VOV+VOO) / 2002 Vacant Lots)	19.8% (627 / 3162)
Remained Occupied (VOO/Early Infill)	95.7% (600 / 627)
Later Vacated (*ReOutflow)* (VOV/Early Infill)	4.3% (27 / 627)
Early Outflow (Time Horizon B) ((OVO+OVV)) / 2002 Occupied Lots)	1.3% (103 / 7923)
Remained Vacant (OVV/Early Outflow)	64.1% (66/103)
ReOccupied (*ReInfill)* (OVO/Early Outflow)	35.9%% (37/103)
Late Infill (Time Horizon C) ((VVO+OVO)/2006 Vacant Lots	16.9% (447 / 2638)
Previously Vacant Lots (VVO/Late Infill)	91.7% (410/447)
Newly Vacated Lots > ***ReInfill*** (OVO/Late Infill))	8.3% (37 / 447)
Late Outflow (Time Horizon C) ((OOV+VOV)/2006 Occupied Lots	1.2% (103 / 8447)
Previously Occupied Lots (OOV)	73.8% (76/103)
Newly Occupied Lots > ***ReOutflow*** (VOV)	26.2% (27/103)

Table 3.4: Detailed Infill/Outflow Breakdown

Given the recent housing crisis and the role that many colonias and IfHSs play in providing affordable homeownership, examination of lot occupation or des-occupation is especially interesting. Additional research is needed to examine the factors and processes behind Re-Infill and Re-Outflow, especially those relating to market performance and supply-side variables (see also Report # 2).

[20] These flip rates and abandonment are the subject of a further study being undertaken in 2011-12 by a team including several of the same researchers. An alternative to abandoning is to rent out, or gift or lend to a family member and while there is evidence for substantial increase in renting in colonias and IFHSs over the past decade, such tenure changes would not be observed in either the CAD or aerial photographic data considered here.

In the previous study, Ward et al (2000) called attention to poorly functioning land markets in colonias and IfHSs, noting only modest increases in land values and lot prices from the early 1980s to 1999 (2000: 7). Given the positive aggregate occupancy change over the past decade and the prominent role of infill in both time horizon B and time horizon C, it appears that market performance in the study communities may have improved. However, at the individual community level one does see notable variation, which we explore the following section.

Trends and Correlations

Individual colonia/IfHSs data reveals several trends in occupation change among the study settlements and neighborhoods. In the nearly three-quarters of the colonias (72.7% [16/22]) the overall occupancy change over the past decade was between 0% and 19%. In addition, as demonstrated previously in Figure 3.1, the total occupancy change in each time horizon was between 0% and 9%. There are, however, some notable exceptions to these aforementioned trends. While both Northridge Acres and Larga Vista experienced negative overall occupation changes (-18% and -0.8%, respectively),[21] Palm Lake's overall occupancy increased by 52.3%.

The Sort and Filter tool in Excel can be used to further explore findings for additional factors that might accompany and/or support apparent variation (see the Data Collection and Analysis Guide). For example, Table 3.5 looks for trends in the community overall occupancy changes and the county where they are located by reorganizing the County, Colonia, and Overall Change columns into county groups. Unfortunately, in this example a clear relationship between these two factors – overall occupancy change and county - is not discernible. In addition, when the data set is quite large and/or the study communities demonstrate a great deal of variation, the Sort and Filter tool may be insufficient to draw useful conclusions.

Excel's correlation analysis tool provides another option for further exploring trends among the variables. As mentioned in the method section of this report, the correlation analysis generates a number, based on the relationship between the individual data points, that speaks to the overall behavioral relationship between two variables. The correlation number ranges between 1.0 (indicating a positive linear relationship, i.e. when X increases, Y increases) and -1.0 (indicating a negative linear relationship, i.e. when X increases, Y decreases). For the purposes of this report a strong or significant correlation is any number above 0.8 (in either direction).

In this report the correlation analysis tool is used to test the relationship between the base vacancy of the colonias and IfHSs and their overall occupancy change. Since several of the communities only had data available from 2002 (Deerfield, Rancho Vista, and Brookhollow), correlations were run on two data sets, a set that included the communities with the 2002 data and a set that did not. The correlation for the data set that did not include the 2002 data was slightly higher (0.861922 without the 2002 data versus 0.813341 with the 2002 data). However, both correlations were high, indicating that colonias and IfHSs with higher base vacancies also experienced higher overall occupancy changes – not surprisingly since they have a greater potential for infill.

[21] Both were quite extensively built out and are now incorporated into the city areas of Laredo and Austin respectively.

County	Colonia	Overall Change in Occupancy
Bastrop	Stony Point	5.7%
Cameron	Cameron Park	12.0%
Cameron	Valle Escondido	16.3%
Cameron	Arroyo Colorado	8.3%
Coryell	Willow Springs	15.8%
El Paso	Vista del Este	2.7%
El Paso	Deerfield Park	8.1%
El Paso	Sparks	19.9%
Guadalupe	Rancho Vista	1.2%
Guadalupe	Brookhollow	5.6%
Hays	Hillside Terrace	7.7%
Hidalgo	Palm Lake	52.3%
Hidalgo	La Mesa	6.0%
Hidalgo	Hoehn Drive	9.1%
Starr	Mike's	22.2%
Travis/Williamson	Northridge Acres	-18.0%
Val Verde	Val Verde	32.5%
Val Verde	Cienegas	19.9%
Webb	Larga Vista	-0.8%
Webb	Rio Bravo	2.3%
Webb	Pueblo Nuevo	11.0%
Webb	Tanquecitos	4.5%

Table 3.5: Overall Change in Occupancy Organized by County

We were also curious to gauge whether other factors beyond the study might be relevant. Specifically, we collected general estimates of the distance from each colonia/IfHSs to the nearest city (as defined by the U.S. census) using Google Earth and total population data of each of those cities from the 2010 U.S. Census. However, neither the proximity to a city nor the total population of that city demonstrated a linear relationship with overall occupancy change. (The correlation coefficients were -0.337 for distance from the nearest city and -0.0596 for the population of the nearest city.) While not significant, the negative relationship is interesting and suggests that the more distant that a colonia or subdivision is from a city, the less infill and occupancy change is likely to occur.

Since the central purpose of this project was to develop and test a methodology for examining lot occupational change in colonias and subdivisions, this report does not further explore the previous options. However, researchers are encouraged to pursue this analysis, ideally incorporating other accessible demographic and economic data that might help build a regression model that approaches causal factors involved in overall occupancy changes in these areas.

Current Vacancies and Alternative Use

In Phase three researchers used tax appraisal data to identify owners of the currently vacant lots in order to explore potential sources of vacancies in the most recent image (2010). Table

3.6 provides data on the results of these searches. Developer lot sales can readily be identified by the frequent appearance of a specific name in the appraisal records. In the study communities developers appear to play only a minor role, accounting for 5.6% of current vacancies; this corroborates the fact that most of the lots have been sold, even if not occupied. Lot combinations (where two adjacent lots are held by a single owner) appear to play a more influential role, accounting for almost 20% of current vacancies. The study methodology differentiates between formal and informal lot combinations. When lots are combined formally the tax appraisal office will join the two parcels under a single property ID, making formal lot combinations easily identifiable. Less easily identifiable, vacant lots were marked as part of an informal lot combination when both the vacant lot and an adjacent lot had (nearly) identical owner names (see Methodology section). Nearly 85% of lot combinations in the study communities were informal. Thus, 17% (382/2294) of current vacancies appear to be the result of informal lot combinations.

Our data suggest that developer owned lots and lot combinations explain one quarter of the vacant lots identified in the most recent images. The remaining of vacant lots (75%) appear to be primarily the result of prolonged vacancies. Indeed, 92.6% of currently vacant lots *have never been occupied*. These findings suggest that absentee ownership remains a key issue in land market performance, and is a severe hindrance to colonia and subdivision consolidation and build out. Further research into the nature, rationale and public policy implications of lot vacancies in these communities along the lines of the Ward et al (2000) study is urgently needed.

Currrently Vacant Lots - 2010		
Type	**% (# / #) of Vacant Lots**	**% (# / #) of Total Lots**
Never Occupied	92.6% (2125 / 2294)	19.2% (2125 / 11085)
Developer Occupied	5.6% (128 / 2294)	1.2% (128 / 11085)
Lot Combination	19.6% (450 / 2294)	4.1% (450 / 11085)
Informal	84.9% (382 / 450)	n/a
Formal	15.1% (68 / 450)	n/a
Currently Occupied Lots - 2010		
Use	**% (# / #) of Occupied Lots**	**% (# / #) of Total Lots**
Alternative	1.5% (133 / 8791)	1.2% (133 / 11085)

Table 3.6: Current Lots Breakdown

The study methodology also offers data on alternative land-use lots for the most recent satellite image (2010). As Table 3.6 demonstrates, only a small percentage (1.5%) of currently occupied lots in the study communities are dedicated to alternative or non-residential uses—most usually parking lots or industrial facilities. (Such data needs to be corroborated on the ground since it is often difficult to discriminate between residential and non-residential uses in aerial photos). Indeed, many of the study communities have live-work units with restaurants, tailors, etc. and many residents offer services such as mariachis and party equipment planning and rentals. Further research into the community-based economies and production would provide a greater understanding of change and consolidation in the study areas.

4) Concluding Discussion: Principal Findings and Policy Implications

A primary purpose of this report was to develop a working method for the analysis of lot occupancy changes in colonias and informal homestead subdivisions in Texas. The accompanying goal was to learn more about changes in 22 case study communities over a ten year period 2000-2010. Examining these changes was important since previous research had demonstrated widespread absentee lot ownership or holding and identified these processes a key constraint for further consolidation and upgrading.

So what are the principal findings that arise from the application of our method and database analysis of these 22 settlements, half of which are in the border and half in central Texas?

1) Overall occupancy increased by 13% from 2000-2010, and vacancy levels were reduced to less than 30% in all but one settlement.

2) Modest overall increases occurred during each of the three "snapshot" periods analyzed (2000-2002; 2000-2006; and 2007-2010), ranging from 5.2 % in the first period to 3.1% in the latter. There does appear to have been some slight slowing in lot occupations since the housing crisis in 2007-2008.

3) The occupation increase was not a linear process. Rather, net growth involved considerable churn or turnover as some lots were vacated and other lots vacated and then re-occupied. Overall, the net loss was lower than the net inflow, and some of the losses were replaced what we call Re-infill (i.e. occupation of previously vacated lots). Of the two time periods that could be analyzed from this perspective, the highest levels of Infill occurred during period B (i.e. between the first and second images) when 20% of vacant lots were occupied, compared to 17% during period C (2006-2010). Both periods also saw some outflow (1.2-1.3% of all lots), but the most recent period (2006-2010 or time horizon C) also saw a higher level of renewed outflow or exiting. Twenty-six percent of the newly occupied lots in the period from 2002-2006 were again vacated between 2006-2010 period. These findings alert us to the fact that there is rather more market turnover than previously recognized, although we have little clear idea of what is driving these changes or how they may vary according to individual colonia or subdivisions characteristics.

4) These changes and turnover notwithstanding, the large majority of formerly vacant lots remained vacant throughout the past decade. Absentee lot ownership remains high: in 2010 almost 20% of over 11,000 lots viewed had never been occupied, representing high opportunity costs for non-development and abandonment. Whether these vacant lots are effectively in the market place or locked out because of owner abandonment or foreclosure for lack of taxes is not known.

5) Of these 20 percent of vacant lots today relatively few (6%) are held by the developers; while 20% appear to be the result of lot combinations – mostly informal combination of adjacent lots by a single owner. Again, however, we know little about whether these are active in the market and/or are held for other kin.

Several important policy implications arise from these findings. To the extent that these continuing high lot vacancies represent an opportunity cost of wider access and greater

community and housing consolidation, the policy imperative remains to promote market activity. As outlined in the 2000 report, this might be through "carrots" such as improved financing opportunities to potential buyers who rely primarily on seller financing. Seller financing worked in the past when lots were held by developers, but are a major constraint in owner-to-owner sales. Similarly, policies to facilitate transfers of repossessed lots, or those lots locked out of the market by property tax delinquencies would also be helpful, as would the offer of priority access to current residents to acquire adjacent vacant lots. Many of these policy approaches work well when they are vested in one or more of the non-profit housing organizations with proven effectiveness, or by a state agency such as the Texas Department of Housing and Community Affairs (TDHCA). Vacant lots can also often be combined to provide picnic or playground areas, and in some configurations even offer shared leach fields or ponding for the septic systems of several dwelling units.

"Sticks" can also be helpful: sequestration of lots from developers or property owners who are delinquent in tax or other payments, combined with a system of land banking and resale by a non-profit, would also open up the market. Similarly, owners who allow their lots to be used for dumping might be penalized through fines.

More research is clearly needed about the reasons for non-occupancy and the interests and rationale for absentee ownership. Deeper inquiry will require creative strategies for follow up analysis of vacant lot residents to ascertain their whereabouts and ongoing interest in continuing to hold the lot as absentee owners, or to gift or deed their properties to would be occupiers. Especially interesting here are those owners who have formally and informally "combined" lots. Interesting, too, will be selective follow up of individuals who have occupied and then vacated their lots: What was the motive for exit? Where are they now? Did the housing finance crisis affect them and, if so, how? In addition, further research is required to analyze and explain some of the variation observed between counties and colonias/IfHSs, perhaps by including a range of other variables in the database (services; lot sizes; characteristics related to socio-economic status; consolidation levels; community size; developer type; evidence of rental and other entrepreneurial activities; state or local government and non-government support and intervention; leadership and community organization indices, etc.). Including these factors would allow for possible regression modeling to help tease out some of the determinants of occupation and population churn.

Our data suggest that, left to the market, changes in occupancy levels are likely to be modest at best. That was a conclusion of the earlier study more than a decade ago, and it remains so today. Taken in combination with the other two reports that form part of this Ford Foundation sponsored study, much could be done to improve housing conditions and community development in colonias and IfHSs, but it requires that we better understand the intersections between housing needs, housing and land markets and public policy, and that we figure out how to join up the dots of this and other research. These are just a few of many ideas that merit creative thought and possible policy development, but until there is an agency or group charged with thinking about these issues, little change is likely.

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